United Nations FCCC/ARR/2017/CAN

Framework Convention on Climate Change

Distr.: General
26 January 2018

English only

Report on the individual review of the inventory submission of Canada submitted in 2017*

Note by the expert review team

Summary

Each Party included in Annex I to the Convention must submit an annual greenhouse gas (GHG) inventory covering emissions and removals of GHG emissions for all years from the base year (or period) to two years before the inventory due date (decision 24/CP.19). This report presents the results of the individual inventory review of the 2017 inventory submission of Canada, conducted by an expert review team in accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories". The review took place from 11 to 16 September 2017 in Bonn, Germany.

* In the symbol for this document, 2017 refers to the year in which the inventory was submitted, not to the year of publication.

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Abbreviations and acronyms

2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
AD	activity data
AWMS	animal waste management systems
B_0	maximum methane-producing capacity of manure
BOD	biochemical oxygen demand
C	confidential
CBM-CFS-3	carbon budget model of the Canadian forest sector
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
CSC	carbon stock change
CV	calorific value
DOC_f	fraction of degradable organic carbon
EF	emission factor
EOR	enhanced oil recovery
ERT	expert review team
FAO	Food and Agriculture Organization of the United Nations
$F_{IND-COM}$	factor for industrial and commercial co-discharged protein into the sewer system
$F_{NON-CON}$	factor for non-consumed protein added to the wastewater
$Frac_{GASM}$	fraction of applied organic nitrogen fertilizer materials and of urine and dung nitrogen deposited by grazing animals that volatilizes as ammonia and nitrogen oxides
$Frac_{leachMS}$	percentage of managed manure nitrogen losses due to run-off and leaching
GCV	gross calorific value
GHG	greenhouse gas
HFC	hydrofluorocarbon
HWP	harvested wood product
IE	included elsewhere
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
kg	kilogram
kha	kilohectare
kt	kilotonne
LKD	lime kiln dust
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
MSW	municipal solid waste
Mt	million tonnes
N	nitrogen
NA	not applicable
NE	not estimated

NGL	natural gas liquid
NH_3	ammonia
NIR	national inventory report
NMVOC	non-methane volatile organic compound
NO	not occurring
NO_x	nitrogen oxides
N_2O	nitrous oxide
PFC	perfluorocarbon
QA/QC	quality assurance/quality control
Revised 1996 IPCC Guidelines	*Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*
SF_6	sulfur hexafluoride
SO_2	sulfur dioxide
t	tonne
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UNFCCC Annex I inventory reporting guidelines	"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories"
UNFCCC review guidelines	"Guidelines for the technical review of information reported under the Convention related to greenhouse gas inventories, biennial reports and national communications by Parties included in Annex I to the Convention"
VS	volatile solids
Wetlands Supplement	*2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*

I. Introduction

1. This report covers the review of the 2017 inventory submission of Canada organized by the secretariat, in accordance with the UNFCCC review guidelines, particularly in part III thereof, namely the "UNFCCC guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention" (decision 13/CP.20). The review took place from 11 to 16 September 2017 in Bonn, Germany, and was coordinated by Mr. Nalin Srivastava, Ms. Claudia do Valle and Ms. Karen Ortega (secretariat). Table 1 provides information on the composition of the ERT that conducted the review of Canada.

Table 1
Composition of the expert review team that conducted the review of Canada

Area of expertise	*Name*	*Party*
Generalist	Ms. Batima Punsalmaa	Mongolia
	Ms. Regine Röthlisberger	Switzerland
Energy	Mr. Christo Christov	Bulgaria
	Ms. Renata Patricia Soares Grisoli	Brazil
	Mr. Jos Olivier	Netherlands
	Mr. Tomoki Takahashi	Japan
IPPU	Ms. Valentina Idrissova	Kazakhstan
	Ms. Eva Krtková	Czechia
	Mr. Lorenz Moosmann	Austria
	Mr. Ole-Kenneth Nielsen	Denmark
Agriculture	Mr. Abdulkadir Bektas	Turkey
	Ms. Sanaa Enkhtaivan	Mongolia
	Ms. Olga Gavrilova	Estonia
LULUCF	Mr. Kevin Black	Ireland
	Mr. Emil Cienciala	Czechia
	Mr. Doru Leonard Irimie	Romania
	Mr. Nagmeldin Elhassan	Sudan
Waste	Mr. Richard Claxton	United Kingdom of Great Britain and Northern Ireland
	Mr. Jose Manuel Ramirez Garcia	Spain
	Ms. Violeta Hristova	Bulgaria
Lead reviewers	Ms. Idrissova	
	Mr. Nielsen	

2. The basis of the findings in this report is assessment by the ERT of the consistency of the Party's 2017 inventory submission with the UNFCCC review guidelines. The ERT has made recommendations that Canada resolve the findings related to issues.[1] Other

[1] Issues are defined in decision 13/CP.20, annex, paragraph 81.

findings, and, if applicable, the encouragements of the ERT to Canada to resolve them, are also included.

3. A draft version of this report was communicated to the Government of Canada, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

4. An overview of the GHG emissions reported under the Convention for Canada is provided in annex I; table 6 shows GHG emissions with and without indirect CO_2 emissions for selected years, and tables 7 and 8 show GHG emissions reported under the Convention by gas and by sector, respectively.

II. Summary and general assessment of the 2017 inventory submission

5. Table 2 provides the assessment by the ERT of the inventory submission with respect to the tasks undertaken during the review. Further information on the issues identified, as well as additional findings, may be found in tables 3 and 5.

Table 2
Summary of review results and general assessment of the inventory of Canada

Assessment			*Issue ID#(s) in table 3 and or 5[a]*
Date of submission	Original submission: 13 April 2017 (NIR), 13 April 2017, Version 4 (CRF tables)		
Review format	Centralized		
Application of the requirements of the UNFCCC Annex I inventory reporting guidelines and Wetlands Supplement (if applicable)	Have any issues been identified in the following areas:		
	(a) Identification of key categories	Yes	G.3, L.3
	(b) Selection and use of methodologies and assumptions	Yes	E.22, I.1, I.13, I.24, A.15, L.11, L.18, W.7
	(c) Development and selection of EFs	Yes	E.2, E.3, E.4, E.13, E.25, E.26, I.24, W.6, W.10
	(d) Collection and selection of AD	Yes	E.1, I.15, L.8, L.13, L.18, W.14, W.15
	(e) Reporting of recalculations	Yes	E.11, E.16
	(f) Reporting of a consistent time series	Yes	I.3, I.10, L.8
	(g) Reporting of uncertainties, including methodologies	No	
	(h) QA/QC	Yes	I.11, A.16, W.12, W.17
	(i) Missing categories/completeness[b]	Yes	E.14, I.2, I.4, I.5, A.3, A.6, A.7, L.1, L.2, L.10, L.16, L.17, W.4
	(j) Application of corrections to the inventory	No	

Assessment			*Issue ID#(s) in table 3 and or 5*[a]
Significance threshold	For categories reported as insignificant, has the Party provided sufficient information showing that the likely level of emissions meets the criteria in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines?	No	E.14, I.2, I.4, I.5, I.6, A.3, L.10, W.4, W.13
Description of trends	Did the ERT conclude that the description in the NIR of the trends for the different gases and sectors is reasonable?	Yes	
National inventory arrangements	Have any issues been identified with the effectiveness and reliability of the institutional, procedural and legal arrangements for estimating GHG emissions, including the changes to the national inventory arrangements since the previous annual submission?	No	
Response from the Party during the review	Has the Party provided the ERT with responses to the questions raised, including the data and information necessary for the assessment of conformity with the UNFCCC Annex I inventory reporting guidelines and any further guidance adopted by the Conference of the Parties?	Yes	
Recommendation for an exceptional in-country review	On the basis of the issues identified, does the ERT recommend that the next review be conducted as an in-country review?	No	

[a] The ERT identified additional issues in all sectors that are not listed in this table but are included in table 3 and/or 5.

[b] Missing categories for which methods are provided in the 2006 IPCC Guidelines may affect completeness and are listed in annex II.

III. Status of implementation of issues raised in the previous review report

6. Table 3 compiles all the recommendations made in previous review reports that were included in the previous review report, published on 16 June 2017.[2] For each issue, the ERT specified whether it believes the issue has been resolved by the conclusion of the review of the 2017 inventory submission and provided the rationale for its determination, which takes into consideration the publication date of the previous review report and national circumstances.

Table 3
Status of implementation of issues raised in the previous review report of Canada

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
General			
G.1	Uncertainty analysis (G.1, 2016) (G.5, 2015) (table 4, 2014) (18, 2013) (24, 2012) (19, 2011) Adherence to the UNFCCC Annex I	Calculate the trend uncertainty, including LULUCF.	Resolved. Canada has presented an uncertainty analysis with and without LULUCF in the NIR (part 1, section 1.6, p.46).

[2] FCCC/ARR/2016/CAN.

ID#	*Issue classification[a]*	*Recommendation made in previous review report*	*ERT assessment and rationale*
	inventory reporting guidelines		
G.2	NIR (G.3, 2016) Transparency	Include information that explains changes over the times series for the key AD, EFs and parameters used in the NIR for fuels combusted (at the level of CRF table 1.A(b)), and disaggregated animal number data where higher tiers are used. The AD, EFs and parameters should be reported in sufficient detail to facilitate (using both the CRF tables and the NIR) the understanding and replication of the calculations of the emission/removal estimates, where applicable.	Not resolved. During the review, Canada informed the ERT that the issue has been noted and will be taken into consideration.
G.3	Key category analysis (G.6, 2016) Transparency	Provide category-specific information on the aggregation of categories in the key category analysis.	Addressing. During the review, Canada clarified that the aggregation of categories is not based on common EFs in all cases and agreed to consider revising the approach towards aggregation of categories for the key category analysis for future submissions.
Energy			
E.1	1. General (energy sector) – gaseous fuels – CO_2, CH_4 and N_2O (E.2, 2016) (E.4, 2015) (19, 2014) Accuracy	Take steps to ensure that the conversion of volumes of natural gas to energy units is completed appropriately for both marketable and non-marketable natural gas. Document the progress on efforts in the improvement plan and in the NIR.	Addressing. According to the NIR (part 1, table A8-4: "Summary of Canada's Inventory Improvement Plan"), data analysis is under way to allow volumes of natural gas to be converted to energy units, by the province in which they are consumed.
E.2	1. General (energy sector) – all fuels – CO_2 (E.3, 2016) (E.11, 2015) Accuracy	Develop a plan that provides a timeline for updating the carbon content factors regularly, prioritizing fuels used in large quantities within Canada, as well as fuels with high carbon content variabilities.	Addressing. According to the NIR (part 1, table A8-4: "Summary of Canada's Inventory Improvement Plan"), Canada initiated a data collection/study to review the carbon content of motor gasoline and diesel to determine if they are still applicable.
E.3	1. General (energy sector) – all fuels – CO_2, CH_4 and N_2O (E.25, 2016) Accuracy	Review and, where necessary, update CVs for other fuels (i.e. other than natural gas as referenced in ID# E.2 in the 2016 inventory review report (see ID# E.1 above)).	Addressing. According to the NIR (part 1, table A8-4: "Summary of Canada's Inventory Improvement Plan"), data analysis is under way to review GCVs for motor gasoline and diesel by Statistics Canada.
E.4	1. General (energy sector) – all fuels – CO_2, CH_4 and N_2O (E.25, 2016) Accuracy	Update CO_2 EFs where appropriate, (following the plan referred to in ID# E.3 in the 2016 inventory review report (see ID# E.2 above)) and provide references for these in the NIR.	Addressing. Canada updated CO_2 EFs for coal (bituminous, lignite and sub-bituminous coals) in the 2017 inventory submission. Canada also reported in the NIR (part 1, table A8-4) that it has initiated a data collection/study to review the carbon

ID#	Issue classification[a]	Recommendation made in previous review report	ERT assessment and rationale
			content of motor gasoline and diesel to determine if they are still applicable. During the review, Canada explained that while it has prioritized improvement plans for CO_2 EFs for coal, natural gas, gasoline and diesel owing to their large contribution to Canada's GHG emissions, it will also develop improvement plans for the other fuels following completion of this work.
E.5	1. General (energy sector) – all fuels – CO_2, CH_4 and N_2O (E.25, 2016) Transparency	Document all instances where the CVs and/or the CO_2 EFs deviate from the ranges set out in the 2006 IPCC Guidelines, and provide concise explanations for the reasons for these deviations, where the reasons are understood; where the reasons are not understood, investigate them.	Not resolved. The ERT noted that CO_2 EFs for motor gasoline and diesel were lower than the ranges set out in the 2006 IPCC Guidelines. However, Canada did not explain the reasons for these differences in the NIR. During the review, Canada explained that lower CO_2 EFs for motor gasoline were attributed to outdated GCVs and it would provide an updated explanation in the 2018 submission (see also ID# E.12 below).
E.6	1.A. Fuel combustion – sectoral approach – all fuels – CO_2, CH_4 and N_2O (E.27, 2016) Transparency	If unable to report the CO_2, CH_4 and N_2O emissions from liquid and gaseous fuels used in coke production (1.A.1.c), all fuels used in food processing, beverages and tobacco (1.A.2.e) and all fuels used in fishing (1.A.4.c.iii) in the expected subcategories, provide information in the NIR indicating under which subcategories they are reported, and include an explanation for the reporting in the NIR.	Resolved. The ERT noted that as indicated in the NIR (part 1, sections 3.2.5.2 and 3.2.7.2, respectively), emissions from all fuels used in food processing, beverages and tobacco (1.A.2.e); and all fuels used in fishing (1.A.4.c.iii) are reported in other manufacturing (1.A.2.g.viii). During the review, the Party clarified that in both cases, energy data are not disaggregated sufficiently to allow reporting these emissions in the expected categories. The ERT also noted that Canada reported in the NIR (part 1, section 3.2.5.2) that emissions from liquid and gaseous fuels used in coke production (1.A.1.c) are reported in iron and steel (1.A.2.a).
E.7	1.A. Fuel combustion – sectoral approach – peat – CO_2, CH_4 and N_2O (E.28, 2016) Transparency	Explain in the NIR that peat is extracted in Canada for agricultural purposes only.	Not resolved. The NIR does not contain any explanation on peat use in the chapters on the energy sector. The ERT noted, however, that the NIR reports in the chapter on the LULUCF sector (part 1, chapter 6) that Canada does not produce peat for use as fuel.
E.8	1.A.1.c Manufacture of solid fuels and other energy industries – all fuels – CO_2, CH_4 and N_2O (E.9, 2016) (E.19, 2015) Comparability	Report the CO_2, CH_4 and N_2O emissions from the purchased fuels used in manufacture of solid fuels and other energy industries in that category.	Addressing. During the review, Canada explained that Statistics Canada was revising the Industrial Consumers of Energy survey by adding mining facilities to this survey, which will provide the AD needed to separate mining and oil and gas emissions in the inventory. Canada further mentioned that it expected to disaggregate oil and gas extraction and mining emissions in the 2018 or 2019 submission.

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
E.9	1.A.1.c Manufacture of solid fuels and other energy industries – solid fuels – CO_2, CH_4 and N_2O (E.29, 2016) Transparency	Add cross-references in the main section of the NIR to the methodological details provided in the relevant annexes to the NIR which describe the estimation of emissions from metallurgical coke production.	Resolved. Canada included cross-references in the main section to the methodological details on the estimation of emissions from metallurgical coke production provided in the annexes to the NIR.
E.10	1.A.1.c Manufacture of solid fuels and other energy industries – solid fuels – CO_2, CH_4 and N_2O (E.29, 2016) Transparency	Clearly state in the NIR the categories where the emissions of each GHG from metallurgical coke production are reported.	Resolved. Canada clarified in the NIR the categories under which the GHG emissions from metallurgical coke production were reported.
E.11	1.A.2 Manufacturing industries and construction – all fuels – CO_2 (E.30, 2016) Adherence to the UNFCCC Annex I inventory reporting guidelines	Provide category-specific information on recalculations that relate to changes in the collection of AD and the choice of EF or method used, including information on the reasoning for the recalculations in the NIR.	Not resolved. Canada provided an explanation on recalculations for this category in the NIR (part 1, sections 3.1 and 3.2.5.5). However, the ERT noted that, although a reference to the relevant study (ECCC, 2016) was included, the reasons for the changes to the coal EFs were not clearly explained in these sections (see ID# E.25 in table 5).
E.12	1.A.3.b Road transportation – gasoline – CO_2 (E.12, 2016) (E.23, 2015) Transparency	Provide an explanation in the NIR that the low IEF for gasoline reported in the CRF tables is attributed to the outdated GCVs used to convert the AD and EF from physical to energy units.	Not resolved. Canada did not provide any explanation on this issue in the NIR. During the review, Canada stated that it would provide updated information on this issue in the 2018 submission.
E.13	1.A.3.b Road transportation – liquid fuels – CO_2 (E.13, 2016) (E.7, 2015) (27, 2014) Accuracy	Carry out the analysis to evaluate the opportunities to repeat portions of the McCann (2000) study to investigate the evolution and current applicability of the final applied EF, and document progress made in this regard in the improvement plan and in the NIR.	Addressing. According to the NIR (part 1, table A8-4: "Summary of Canada's Inventory Improvement Plan"), Canada has initiated the necessary data collection/study to implement this recommendation.
E.14	1.A.3.c Railways – solid fuels – CO_2, CH_4 and N_2O (E.14, 2016) (E.24, 2015) Completeness	Either estimate and include in the inventory CO_2, CH_4 and N_2O emissions from steam trains, or provide a justification in the NIR, consistent with the UNFCCC Annex I inventory reporting guidelines, that these emissions are considered insignificant.	Addressing. Although the NIR (part 2, section A3.1.4.2.4), provides the explanation that based on a review of emissions of steam train operations in Canada, the emissions associated with steam trains are considered insignificant, it does not provide sufficient information on this review. During the review, Canada explained that it had carried out a survey of steam train companies in 2015, which found that GHG emissions from steam trains were negligible but it did not provide a justification for their insignificance in the NIR, consistent with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
E.15	1.A.3.e Other transportation – all fuels – CO_2, CH_4 and N_2O (E.17, 2016) (E.26, 2015) Comparability	Document the progress made in reallocating the associated emissions from the subcategory fuels used in off-road activities under agriculture and forestry to the subcategory off-road vehicles and other machinery (agriculture/forestry/fishing).	Resolved. Canada reallocated emissions from fuels used in off-road activities under agriculture and forestry to the subcategory off-road vehicles and other machinery (agriculture/forestry/fishing).
E.16	1.A.4 Other sectors – all fuels – CH_4 and N_2O (E.32, 2016) Adherence to the UNFCCC Annex I inventory reporting guidelines	Provide category-specific information on recalculations that relate to changes in the collection of AD and the choice of EF or method used, including information on the reasoning for the recalculations in the NIR.	Addressing. Although Canada provided explanations for recalculations in this category in the NIR (part 1, section 3.2.7.5), the ERT noted that the reasons for the changes in the AD and EFs were not clearly explained in this section (see also ID# E.25 in table 5).
E.17	1.B.1.a Coal mining and handling – solid fuels – CO_2 (E.20, 2016) (E.29, 2015) Transparency	Report the CO_2 emissions from underground mines as "NA" and indicate in the NIR that no CO_2 emissions associated with flaring and drainage systems of underground mines occur in the country.	Addressing. The ERT, while noting that the notation key "NA" has been used in CRF table 1.B.1, was unable to find any reference in the NIR to the emissions associated with flaring and drainage systems of underground mines. During the review, Canada explained that the NIR (part 2, section A3.2.1.1) mentions that the two remaining underground mines in Canada were non-gassy, and it was generally understood that no flaring or drainage system was needed for them. Canada also stated in its response that the more gassy underground mines that had operated during the 1990s had no flaring or operating drainage systems and that it would specifically report that no flaring or drainage systems existed during the reporting period 1990 to 2016 in the NIR in the next submission.
E.18	1.B.1.a Coal mining and handling – solid fuels – CH_4 (E.22, 2016) (E.32, 2015) Accuracy	Transparently explain in the NIR the assumptions, country-specific surface mines data, parameters and information from the national studies that were used, in order to justify the accuracy of the emission calculations. If this information is not available, then, as a first step, for emissions from surface mines which were estimated by using the adjusted Coal Industry Advisory Board methodology, apply the respective tier 1 method from the 2006 IPCC Guidelines, and afterwards plan and implement the application of a tier 2/tier 3 method that will be transparently described in the NIR, provided that it is developed in a manner consistent with the 2006 IPCC Guidelines and following the	Resolved. Although Canada updated the explanation on the methodologies in the NIR (part 2, section A.3.2.1.1), the ERT could not find clear information justifying the accuracy of the adjusted Coal Industry Advisory Board methodology. During the review, Canada explained that the facility-specific information from the three studies (Hollingshead (1990), King (1994) and Cheminfo/Clearstone (2014)), upon which Canada based its country-specific data, parameters and information regarding surface mines, was considered confidential. The ERT also noted that as mentioned in the 2016 inventory review report, Canada explained that that the adjusted Coal Industry Advisory Board methodology approach is a tier 2/tier 3, country-specific method and that the several previous ERTs who were provided access to the industry

ID#	Issue classification[a]	Recommendation made in previous review report	ERT assessment and rationale
		provisions of paragraph 41 of the UNFCCC Annex I inventory reporting guidelines.	report containing this method via a confidentiality agreement during in-country reviews did not provide a recommendation that Canada apply the IPCC tier 1 approach. Based on the above, the ERT considers the issue resolved (see also ID# E.29 in table 5).
E.19	1.B.1.b Solid fuel transformation – solid fuels – CO_2, CH_4 and N_2O (E.23, 2016) (E.34, 2015) Transparency	Verify that the emissions from all coke oven gas both consumed and flared at the four integrated iron and steel plants are included in the inventory and report accordingly in the NIR.	Addressing. The ERT considers that the information on the estimation of emissions from coke oven gas included in the NIR (part 1, section 3.2.5.2) is not fully transparent because it does not clarify whether the emissions from all coke oven gas both consumed and flared at the four integrated iron and steel plants are included in the inventory. During the review, Canada mentioned that a review of coke oven gas consumption data reported to Statistics Canada confirmed that it included the data reported by all integrated iron and steel plants in operation. Canada also confirmed on the basis of conversations with integrated plants that the coke oven gas consumption data included all fuel combusted for flaring and energy uses, without double counting. The ERT, however, noted that this information has not been included in the NIR.
E.20	1.B.1.b Solid fuel transformation – solid fuels – CO_2 and CH_4 (E.33, 2016) Transparency	Report CO_2 and CH_4 emissions from briquette manufacturing under solid fuel transformation. If this cannot be done, use the correct notation key for solid fuel transformation ("IE" instead of "NE") and update the description in the NIR accordingly.	Not resolved. Canada neither reported CO_2 and CH_4 emissions from briquette manufacturing under solid fuel transformation nor changed the notation key from "NE" to "IE".
E.21	1.B.1.b Solid fuel transformation – solid fuels – CO_2 and CH_4 (E.33, 2016) Transparency	Document the methodology and data sources used to estimate emissions from briquette manufacturing in the NIR.	Not resolved. Canada did not document the methodology and data sources used to estimate emissions from briquette manufacturing in the NIR.
E.22	1.B.2.a Oil – liquid fuels – CH_4 (E.24, 2016) (E.9, 2015) (29, 2014) Accuracy	Continue to explore ways to review and update the bitumen model to capture industry changes and document progress on this in the improvement plan and in the NIR.	Addressing. Canada did not document progress on reviewing and updating the bitumen model to capture industry changes in the improvement plan in the NIR (part 1, section 8.3). During the review, Canada indicated that a study to update emission estimates for bitumen production had been completed and was currently under review. Canada expects to include the results of this study in the 2019 submission.
IPPU			
I.1	2.A.2 Lime production – CO_2	Improve the tier 2 method used by including the correction factor for	Not resolved. In response to a question from the ERT during the review, Canada stated

ID[a]	Issue classification[a]	Recommendation made in previous review report	ERT assessment and rationale
	(I.15, 2016) Accuracy	LKD using the IPCC default value (2006 IPCC Guidelines, volume 3, p.2.24), if a country-specific LKD correction factor is not available.	that the recommendation will be implemented in the 2018 submission.
I.2	2.A.4 Other process uses of carbonates – CO_2 (I.2, 2016) (I.10, 2015) Completeness	Include CO_2 emissions from ceramics production in the inventory or demonstrate that the emissions are insignificant, as defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Not resolved. Canada did not estimate and report emissions from ceramics production (i.e. reported as "NE" in CRF table 2(I).A-Hs1), and did not provide information demonstrating that those emissions are insignificant as per paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. The ERT noted that ceramics production activity is covered by North American Industry Classification System category 32711, "Pottery, Ceramics and Plumbing Fixture Manufacturing", with a total number of 216 establishments in Canada. During the review, the Party explained that it had consulted with another government department to determine how the current AD can be used to develop emission estimates for ceramics production. However, due to the way data were collected (i.e. raw materials used for ceramics production are potentially aggregated with those used in other sectors), it was difficult to accurately estimate emissions from ceramics production based on those data. As such, the Party is planning a study to estimate the emissions from ceramics production.
I.3	2.B.2 Nitric acid production – N_2O (I.16, 2016) Consistency	Investigate why there is such an inconsistency between the statistical data (showing decreasing nitric acid production in the period 2007–2008) and the data reported by facilities (showing increasing production in the period 2007–2008) and whether there could be any errors in the data reported by the facilities, and report on the results of such an investigation in the NIR, including information on the QA/QC activities undertaken in relation to the facility-level data received.	Addressing. During the review, Canada stated that it has investigated and resolved the inconsistency between the two data sources. Canada explained that the emissions for 2007 and 2008 were estimated based on nitric acid production values directly reported by facilities, which were reported in an aggregate form in the CRF tables to ensure confidentiality of the data on production by individual producers. Canada clarified that the apparent inconsistency was probably because a facility did not report nitric acid production data to Statistics Canada for 2008, which thus were not included in the production data published by Statistics Canada. Having reviewed and determined that there is a sufficient number of reporters such that the aggregation of production data would protect the confidentiality of individual facility data, Canada plans to use the production data used in the estimation in the CRF tables in the 2018 submission. Canada further stated that the QC checks performed

ID[a]	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
			on the data are consistent with the 2006 IPCC Guidelines and the text in the NIR will be updated in the next submission.
I.4	2.B.6 Titanium dioxide production – CO_2 (I.17, 2016) Completeness	Confirm that the emissions from titanium dioxide production are included in the inventory and report the CO_2 emissions under category 2.B.6 (titanium dioxide production). If the emissions are reported under another subcategory, explain so in the NIR.	Addressing. During the review, Canada explained that there is only one facility in Canada that produces titanium dioxide using the chloride process. Based on a study conducted in 2010, Canada has determined that the CO_2 emissions from this facility's chloride process are very small (less than 0.01 per cent of the national total emissions), and therefore insignificant. Canada further informed the ERT that it intends to change the notation key from "IE" to "NE", including the justification for insignificance of emissions, in the NIR in the next submission. The ERT noted, however, that the NIR did not include a justification for considering the emissions from this category as insignificant as per paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines by calculating a likely level of emissions using approximate AD and IPCC default EFs.
I.5	2.B.8 Petrochemical and carbon black production – CO_2 and CH_4 (I.3, 2016) (I.11, 2015) Completeness	Include CO_2 and CH_4 emissions from ethylene oxide production in the inventory or demonstrate that the emissions are insignificant, as defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Not resolved. During the review, Canada stated that efforts to address this issue are ongoing, but no specific progress has been made.
I.6	2.B.8 Petrochemical and carbon black production – CO_2 (I.18, 2016) Comparability	Include in the inventory CO_2 emissions from carbon black production or justify its exclusion in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Addressing. Canada reports the notation key "IE" for these emissions. During the review, Canada explained that process CO_2 emissions from carbon black production are reported under CRF category 2.D (non-energy products from fuels and solvent use), because the CO_2 emissions from that category cannot be disaggregated. Canada also stated that it would provide additional details in the 2018 submission to clarify the use of the notation key "IE" for CO_2 emissions from carbon black production.
I.7	2.C.1 Iron and steel production – CO_2 (I.4, 2016) (I.5, 2015) (37, 2014) Transparency	Include the allocation of non-energy use of other reductants identified in this category in the improvement plan and implement steps to further disaggregate the energy statistics and other (industrial processes) category.	Not resolved. The issue has not been addressed and is still included among planned inventory improvements (part 1, section 8.3) in the NIR.
I.8	2.C.1 Iron and steel production – CO_2	More transparently describe the allocation of emissions from ferroalloys production in the NIR.	Not resolved. The NIR does not include a description of allocation of emissions from feroalloys production.

ID[a]	Issue classification[a]	Recommendation made in previous review report	ERT assessment and rationale
	(I.19, 2016) Transparency		
I.9	2.C.3 Aluminium production – CO_2 and PFCs (I.20, 2016) Comparability	Correct the AD reported in CRF tables 2(I).A-Hs2 and 2(II)B-Hs1 and adjust the AD to the unit of kt for reporting in CRF table 2(I).A-Hs2.	Resolved. The AD are correctly reported in the CRF tables.
I.10	2.C.4 Magnesium production – SF_6 (I.21, 2016) Consistency	Check the AD reported for 1999–2000 and revise them, if appropriate.	Not resolved. The NIR does not address the possible inconsistency in AD on magnesium production across the time series. During the review, Canada explained the significant increase in magnesium production across the period 1999–2000 as the consequence of a new facility beginning its operation in 2000 and the other two facilities increasing their SF_6 use by more than 30 per cent between 1999 and 2000. The Party further explained that it would include, in the NIR of the next submission, the explanation that it provided during the review to increase the transparency of its reporting.
I.11	2.C.4 Magnesium production – SF_6 (I.21, 2016) Adherence to the UNFCCC Annex I inventory reporting guidelines	Improve the QA/QC procedures in order to detect such fluctuations in IEFs and provide a corresponding explanation in the NIR.	Not resolved. The NIR did not include an explanation for fluctuations in IEFs or information on the improved QA/QC procedures to detect such fluctuations. The Party further explained that it would include, in the NIR of the next submission, some information regarding its current QC procedures that include a step for detecting large fluctuations or anomalies in the IEFs.
I.12	2.D Non-energy products from fuels and solvents use – CO_2 and CH_4 (I.8, 2016) (I.6, 2015) (37 and 41, 2014) (47, 2013) (78, 2012) (77, 2011) Transparency	Implement the scheduled improvements for this category, reporting on progress in future inventory submissions, and continue the improvements necessary to document the methods and sources of AD and EFs in the NIR.	Addressing. In the 2016 submission, Canada reallocated emissions from methanol and ethylene production. However, Canada has made no effort to further disaggregate the emissions in order to enhance transparency and comparability. During the review, Canada further clarified that although some efforts have been made in this direction, as explained in the NIR (part 1, section 4.13.6), there are no specific improvements planned for this category. However, as information that would allow the disaggregation of fuel data and allocation to the appropriate category for other (more specific) categories (e.g. iron and steel production) becomes available, emissions in the category non-energy products from fuel and solvent use will be revised.
I.13	2.D.1 Lubricant use – CO_2 (I.22, 2016) Accuracy	Implement the methodology provided in the 2006 IPCC Guidelines for this key category by applying a factor of 0.2 for the amount of lubricants oxidized during	Not resolved. During the review, Canada explained that it intends to apply the methodology provided in the 2006 IPCC Guidelines for the estimation of emissions from oxidation of lubricants during their use

ID[a]	*Issue classification[a]*	*Recommendation made in previous review report*	*ERT assessment and rationale*
		use.	and due to the end of their use in the 2018 submission.
I.14	2.D.1 Lubricant use – CO_2 (I.22, 2016) Transparency	Explain in the NIR how the emissions from oxidation of lubricants during their use and due to the end of their use are estimated and in which CRF categories the emissions are reported.	Not resolved. During the review, Canada explained that it intends to apply the methodology provided in the 2006 IPCC Guidelines for the estimation of emissions from oxidation of lubricants during their use and due to the end of their use, in addition to correctly allocating these emissions to the category 2.D.1 in the next submission.
I.15	2.D.3 Other (non-energy products from fuels and solvent use) – other (I.23, 2016) Accuracy	Improve the consistency of the information provided in CRF table 1.A(d) and in the IPPU sector, in particular regarding categories 2.D.3 (non-energy products from fuels and solvent use – other) and 2.B.8 (petrochemical and carbon black production).	Not resolved. There is still a lack of consistency between the information reported in CRF table 1.A(d) and in the IPPU sector in the 2017 submission.
I.16	2.F. Product uses as substitutes for ozone-depleting substances – HFCs (I.12, 2016) (I.17, 2015) Accuracy	Correct the identified problems in estimates for manufacturing and servicing/maintenance emissions, as well as in the foam blowing, fire protection, aerosols, solvents and electrical equipment subcategories, in order to allow the correct utilization of either the tier 2a method (with data for emissions related to the management of refrigerant containers, emissions related to the refrigerant charge, annual emissions from the banks of refrigerants and servicing emissions at system disposal) or the tier 2b method (with data for annual sales of new refrigerant, total charge of new equipment, original total charge of retiring equipment and amount of intentional destruction) from the 2006 IPCC Guidelines.	Resolved. Canada corrected the issue in the 2017 submission in the CRF tables and also provided a description of the methodology in the NIR (part 1, section 4.15 and part 2, annex 3.3).
I.17	2.F. Product uses as substitutes for ozone-depleting substances – HFCs (I.13, 2016) (I.18, 2015) Consistency	Apply the methodology presented in the 2006 IPCC Guidelines for refrigeration and air conditioning for the entire time series (including for 1995–1998), and, if this is not possible, use one of the techniques provided in the 2006 IPCC Guidelines to estimate the missing values.	Resolved. Canada has recalculated the emissions from product uses as substitutes for ozone-depleting substances (category 2.F) for the entire time series using the methodology provided in the 2006 IPCC Guidelines.
I.18	2.G Other product manufacture and use – SF_6 (I.24, 2016) Completeness	Investigate whether manufacture of electrical equipment (category 2.G.1) occurs in Canada. If manufacture does occur, estimate the related SF_6 emissions, or, if it does not occur,	Resolved. Canada has changed the notation key to "NO" to reflect that manufacturing does not occur in Canada.

ID	Issue classification[a]	Recommendation made in previous review report	ERT assessment and rationale
		use the notation key "NO" instead of "NE" in CRF table 2(II)B-Hs2.	
Agriculture			
A.1	3. General (agriculture) – CH_4 and N_2O (A.1, 2016) (A.11, 2015) Completeness	Provide documentation to support the reporting that there were no wild boar between 1990 and 1996 or extrapolate from the available data (from Statistics Canada), to fill the population data gap instead of using 0 (zero) for the years between 1990 and 1996.	Resolved. According to the NIR, (part 1, table A8-3) Canada has included the wild boar population estimates prior to 2001 from the 1991 and 1996 census of agriculture (since data on the wild boar population were not collected before 1991, the population figure for 1990 was assumed to be the same as that for 1991). Previously, Canada extrapolated the wild boar populations before 2001 to 0.
A.2	3.A.4 Other livestock – CH_4 (A.11, 2016) Adherence to the UNFCCC Annex I inventory reporting guidelines	Report the correct weight for goats in CRF table 3.As2.	Resolved. Canada has reported the same weight (64.00 kg) for goats in CRF tables 3.As2 and 3.B(a)s1.
A.3	3.B Manure management – CH_4 and N_2O (A.12, 2016) Completeness	Provide in the NIR the reasons why emissions from anaerobic lagoon and daily spread have not been estimated, in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Not resolved. Canada used the notation key "NE" to report emissions from anaerobic lagoon and daily spread in CRF tables 3.B(a)s2 and 3.B(b), without providing a justification for reporting them as such in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. The ERT also noted that while the NIR (part 2, section A3.4.3.4) provided the explanation that no specific data were available for covered lagoons and biodigesters and they are assumed to be part of other systems, the documentation boxes in CRF tables 3.B(a)s1 and 3.B(b) state that anaerobic lagoons and daily spread may exist in Canada but since they are not included in Marinier et al. (2004), the source of data on allocation to AWMS for Canada, they are assumed to be negligible.
A.4	3.B.4 Other livestock – CH_4 (A.13, 2016) Transparency	Provide in the NIR an explanation for the assumption that the fraction of manure handled by AWMS is the same for llamas and alpacas as for sheep and lambs.	Resolved. Canada has provided an explanation in the NIR (part 2, section A3.4.3.6) that based on similarities in species and in production practices, sheep are used as a proxy for llamas and alpacas to estimate emissions.
A.5	3.B.4 Other livestock – CH_4 (A.14, 2016) Transparency	Exclude from the NIR the default values from the 2006 IPCC Guidelines for B_0 and methane conversion factor for mules and asses, which are not used in the inventory.	Resolved. Canada has excluded the default values for B_0 and methane conversion factor for mules and asses from the 2006 IPCC Guidelines, which are not used in the inventory, from tables A6-29 and A6-30 in the NIR.

ID[a]	Issue classification[a]	Recommendation made in previous review report	ERT assessment and rationale
A.6	3.D Direct and indirect N_2O emissions from agricultural soils – N_2O (A.9, 2016) (A.16, 2015) Completeness	Report direct N_2O emissions from sewage sludge and other organic fertilizers applied to soils.	Not resolved. Canada has not reported direct N_2O emissions from sewage sludge and other organic fertilizers applied to soils in CRF table 3.D (the notation key "NE" was used for both subcategories) with the explanation in the NIR (part 2, table A5-1) that data on the amount of nitrogen in sewage sludge and other organic fertilizers applied to soils are not available.
A.7	3.D.b Indirect N_2O emissions from managed soils – N_2O (A.15, 2016) Completeness	When estimating direct N_2O emissions from application of sewage sludge and other organic fertilizers to soils, also estimate the related indirect N_2O emissions.	Not resolved. Canada did not report the indirect N_2O emissions from application of sewage sludge and other organic fertilizers to soils. During the review, the Party explained that efforts to address this issue are ongoing but did not specify a deadline for the completion of the work.
A.8	3.D.b.1 Atmospheric deposition – N_2O (A.16, 2016) Comparability	Correct the reporting of $Frac_{GASM}$ in the additional information table of CRF table 3.D to correspond to the $Frac_{GASM}$ value (0.2 kg NH_3-N+NO_X-N/kg N) provided in the 2006 IPCC Guidelines, which was used in the inventory.	Not resolved. Canada has not corrected the value of $Frac_{GASM}$ reported in the additional information table of CRF table 3.D (0.31) to make it consistent with the $Frac_{GASM}$ value (0.2 kg NH_3-N +NO_X-N/kg N) provided in the 2006 IPCC Guidelines, which was used in the inventory. During the review, the Party explained that efforts to address the issue are ongoing but did not specify a deadline for the completion of the work.
A.9	3.G Liming – CO_2 (A.17, 2016) Consistency	Continue efforts to find a data source for liming in agriculture (constant AD had been reported for 2012, 2013 and 2014).	Resolved. Canada has reported in the NIR (part 1, table A8-3) that data on agricultural use of lime for 2013 and 2014 have been updated following the recommendation of the ERT.
A.10	3.G Liming – CO_2 (A.17, 2016) Consistency	Until a new data source (for liming in agriculture) is identified, increase the consistency of emission estimates by extrapolating data for the missing years (2013 and 2014).	Resolved. Canada has reported in the NIR (part 1, table A8-3) that the data on agricultural use of lime for 2013 and 2014 have been revised.
LULUCF			
L.1	4. General (LULUCF) (L.2, 2016) (L.4, 2015) (59, 2014) (9 and 63, 2013) Completeness	Improve the completeness of reporting of the pools in all mandatory categories currently reported as "NE" and include a description on how the notation keys have been used.	Addressing. Canada has reported CSC in pools in some mandatory categories as "NE" (e.g. CSC in mineral soils in grassland remaining grassland). However, Canada has also not included a transparent description of how the notation keys have been used, particularly when using "NO" or "NE" for pools in land-use subcategories for which there exist AD (land areas).
L.2	4. General (LULUCF) (L.3, 2016) (L.13, 2015) Completeness	Improve the completeness for representing land areas in the LULUCF sector by amending the reporting (both the land-use change matrix and the estimates for category-specific emissions/removals	Addressing. Canada has included the area of cropland converted to settlements in the land-use change matrix, but it has not reported emissions and removals from this, and some other mandatory categories as referenced in the NIR (part 2, annex 5, table

ID#	*Issue classification[a]*	*Recommendation made in previous review report*	*ERT assessment and rationale*
		in the CRF tables) by including all land areas and making it clear which categories and subcategories occur in Canada and whether the emissions/removals are calculated or not. This includes both managed land areas where no emissions/removals are expected (e.g. grassland remaining grassland) as well as unmanaged areas.	A5-1). Improvement plans in the NIR (part 1, table A8-4) highlight approaches being considered to improve reporting on the categories whose emissions and removals have not been reported, but no timeline for the completion of the work is mentioned.
L.3	4. General (LULUCF) (L.14, 2016) Adherence to the UNFCCC Annex I inventory reporting guidelines	Provide more details in the NIR on how the CRF categories are disaggregated in the Canadian key category analysis, in accordance with paragraph 50(d)(ii) of the UNFCCC Annex I inventory reporting guidelines, particularly in relation to where emissions from biomass burning are included.	Not resolved. Canada did not provide detailed information on how CRF categories are disaggregated in the key category analysis in the NIR (part 2, annex 1). During the review, Canada acknowledged that the information on how CRF categories are disaggregated in the key category analysis is not sufficiently explained in the NIR. Canada further informed the ERT that biomass burning emissions are included under the land-use category where they occur (e.g. forest land remaining forest land). Canada plans to better document the key category analysis in the NIR in the next submission.
L.4	Land representation (L.16, 2016) Transparency	Specify in the NIR that the total land area is included in the inventory and report the land area in CRF table 4.1 separately for unmanaged forest, unmanaged grassland and unmanaged wetlands.	Not resolved. Canada has not specified in the NIR that the total land area of Canada has been included in the inventory. The ERT notes that the total land area of Canada is different for some years in the time series (ranging from 996,357.06 kha to 996,398.21 kha). Canada has also not separately reported managed and unmanaged areas for forest land, grassland and wetlands. During the review, Canada indicated that there are no plans to quantify areas of unmanaged and managed land for land-use categories other than forest land (see ID# L.15 in table 5).
L.5	Land representation (L.17, 2016) Transparency	Include in the NIR the correction of the reporting in CRF table 4.1 (to include information on annual changes) as part of the planned improvement, along with any update on the status of implementation of other parts of the ongoing project to revise and improve the consistency and completeness of the land transition matrix.	Addressing. Canada has included in the NIR the correction to the land-use matrix by including the annual area changes. Although planned improvements in the NIR (part 1, table A8-4) mention improving the completeness and consistency of the land transition matrix as one of the priority areas, the NIR does not provide a timeline for the implementation of the work.
L.6	4.A Forest land – CO_2 (L.5, 2016) (L.6, 2015) (63, 2014)	Provide further numerical examples of verification activities of the CBM-CFS-3 model at the pool level, as well as pool-specific uncertainties in	Resolved. Canada did not provide numerical examples of verification activities of the CBM-CFS-3 model at the pool level, as well as pool-specific uncertainties in the NIR. The ERT, however, believes that this

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	Transparency	the NIR.	information is not relevant since Canada's approach is based on the gain-loss method and thus uncertainty is estimated for annual GHG flux estimates by gas and disturbance type, which is reported in the NIR. The ERT notes that the 2006 IPCC Guidelines do not require estimation of uncertainty or verification at the pool level.
L.7	4.A Forest land – CO_2, CH_4 and N_2O (L.19, 2016) Comparability	Disaggregate the CSC in mineral and organic soils to increase transparency and comparability and ensure that the emissions are neither under- nor overestimated.	Addressing. Canada has implemented a new approach to report emissions from peatland conversion for peat extraction in 2017. Canada also indicated that a peatland module for the CBM-CFS-3 model is under development (currently in the research phase) with the aim of estimating emissions and removals from organic soils in forest land.
L.8	4.A.2 Land converted to forest land – CO_2 (L.7, 2016) (L.19, 2015) Accuracy	Provide additional information on why using zero for annual area conversions to forest land for the period 2009–2013 is considered reasonable compared with other alternative ways to construct the time series. Continue with efforts to acquire the missing AD for land converted to forest land.	Not resolved. Although the NIR outlines improvement plans to gather information on afforestation since 2009 (part 1, sections 6.3.2.2 and 6.3.2.6), it does not provide a timeline for the completion of the task.
L.9	4(II) Emissions and removals from drainage and rewetting and other management of organic/mineral soils – CH_4 and N_2O (L.9, 2016) (L.5, 2015) (61, 2014) Completeness	Provide evidence that drainage does not occur on forest land and consider whether the notation key "NE" should be used instead of the notation key "NO" for emissions of CH_4 or N_2O.	Resolved. Canada has used the notation key "NE" in CRF table 4(II) for drained organic soils in forest land. Although Canada has implemented the previous recommendation to report the notation key "NE", the ERT notes that there is still a completeness issue related to reporting of CO_2 and N_2O emissions from drainage in forest land (see ID# L.16 in table 5).
L.10	4(III) Direct N_2O emissions from N mineralization/ immobilization and 4(IV) indirect N_2O emissions from managed soils –N_2O (L.10, 2016) (L.24, 2015) Completeness	Estimate all the direct N_2O emissions as well as the associated indirect N_2O emissions from nitrogen mineralization/immobilization associated with loss/gain of soil organic matter. Until the estimation is implemented, provide information on the planned improvement and assessment of the quantitative impact of this missing category in accordance with the provisions in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Not resolved. Canada reported "NE" in CRF table 4(III) for direct N_2O emissions from nitrogen mineralization/immobilization associated with loss/gain of soil organic matter on forest land, grassland remaining grassland and settlements and the Party did not provide information on any planned improvement or an assessment of the quantitative impact of this missing category in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines in the NIR. Canada reported direct N_2O emissions from nitrogen mineralization/immobilization associated with loss/gain of soil organic matter from wetlands and indirect N_2O emissions from managed soils as "IE" (in CRF table 4(IV)) with no information provided in CRF table

ID#	Issue classification[a]	Recommendation made in previous review report	ERT assessment and rationale
			9 where these emissions are reported. During the review, Canada provided detailed information on future plans to report N_2O emissions from forest soils (see also ID# L.16 in table 5).
L.11	4(V) Biomass burning – CO_2 (L.21, 2016) Accuracy	Include indirect CO_2 emissions from atmospheric oxidation of CO emissions due to biomass burning in CRF table 6 and exclude them from CRF table 4(V) to correct the identified double counting of indirect CO_2 from CO emissions.	Not resolved. During the review, Canada explained that this issue will be corrected in the next submission, clarifying that it could not be addressed in this year's submission because it was first raised in the first draft of the inventory review report received at the end of February 2017, when it was already too late in the inventory cycle to correct the error.
L.12	4(V) Biomass burning – CO_2 (L.21, 2016) Transparency	More clearly explain in the NIR which source emissions are considered as indirect CO_2 and how these indirect emissions have been calculated.	Not resolved. During the review, the Party explained that the information on the source of indirect emissions of CO_2 and methods used to calculate these emissions will be documented in the NIR in the next submission.
L.13	4.G Harvested wood products – CO_2 (L.13, 2016) (L.22, 2015) Accuracy	Include data for 1900–1940 for estimating emissions from the category HWP, as part of the improvement work in relation to the category, and consider how the uncertainty may be affected.	Addressing. Canada has evaluated the validity of using back-cast estimates derived from FAO statistical data to estimate inflows into the HWP pool for the period 1900–1940. Canada has, therefore, indicated that it plans to include data for 1900–1940 for estimating emissions from the HWP pool in the next submission. The Party has not addressed how uncertainty may be affected by the inclusion of such data.
L.14	4.G Harvested wood products – CO_2 (L.22, 2016) Comparability	Modify the reporting of the HWP pool, so that the HWP estimates can be compared with those of other Parties.	Resolved. The ERT notes that Canada uses a tier 3 approach for estimating the emissions from the HWP pool in which the carbon inflow values for different products with different half-lives are aggregated. Thus, the existing design of CRF table 4.Gs1 does not facilitate the reporting of carbon stock inflows and emissions in a transparent way. The Party has highlighted this problem and provided information on how to interpret the data in the NIR (part 1, section 6.3.1.2). During the review, Canada provided more detailed information clearly showing how HWP CSC have been calculated (see ID# L.19 in table 5). Based on this information, the ERT is satisfied that the methods used are accurate and comparable to the approaches contained in the 2006 IPCC Guidelines.
Waste			
W.1	5.A Solid waste disposal on land – CH_4	Include in the NIR the rationale for the allocation of emissions from wood waste landfills to the category	Resolved. The Party has reported wood waste as "unmanaged" rather than "uncategorized" in the CRF tables

ID[a]	Issue classification[a]	Recommendation made in previous review report	ERT assessment and rationale
	(W.5, 2016) (W.15, 2015) Transparency	uncategorized waste disposal sites.	consistent with the rationale provided in the NIR (part 1, section 7.2).
W.2	5.A Solid waste disposal on land – CH_4 (W.20, 2016) Transparency	Categorize the wood waste disposal sites as unmanaged and use this categorization in the NIR and in the CRF tables.	Resolved. Canada has recalculated the emissions from solid waste disposal on land by categorizing wood waste disposal sites as unmanaged waste disposal sites (5.A.2) and by revising the methane correction factor value as relevant to this category (0.8) as described in the NIR (part 1, section 7.2).
W.3	5.B. Biological treatment of solid waste – N_2O (W.21, 2016) Accuracy	Use the corrected IPCC default EF value as the N_2O EF for composting, based on wet weight (0.24 g N_2O/kg).	Resolved. The Party has recalculated the N_2O emissions from composting using the default EFs in the 2006 IPCC Guidelines based on wet weight.
W.4	5.B.2 Anaerobic digestion at biogas facilities – CH_4 (W.22, 2016) Completeness	Include in the NIR the approximate estimate of CH_4 emissions from anaerobic digestion at biogas facilities, to justify that the emissions are below the threshold defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Not resolved. Canada has not included in the NIR any information to justify that CH_4 emissions from anaerobic digestion at biogas facilities can be considered insignificant according to paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. During the review, the Party stated that because anaerobic digestion is an emerging technology in Canada, it has not developed emission estimates from anaerobic digestion of waste owing to a lack of a complete data set on the number of anaerobic digesters in operation in Canada and the amount of waste processed by them as listed in the improvement plan in the NIR (part 2, table A8-4), and that it planned to develop estimates for this category following the availability of sufficient AD. The Party further stated that it has planned a study to obtain AD to develop emission estimates for this category. However, pending the availability of such AD, it will continue to consider these emissions as "insignificant" while providing justification for not estimating them in the NIR.
W.5	5.C.1 Waste incineration (W.10, 2016) (W.2, 2015) (73, 2014) (83, 2013) (53, 2012) (31, 2011) Comparability	Report all emissions related to energy recovery in the energy sector.	Addressing. During the review, Canada stated that, owing to a lack of AD on the amount of waste incinerated for energy recovery, it currently does not separately report emissions with and without energy recovery, but it is planning to improve its reporting in the future based on the availability of AD.
W.6	5.C.1 Waste incineration – N_2O (W.11, 2016) (W.22, 2015)	Either justify the continued use of the default EF from the Revised 1996 IPCC Guidelines as appropriate to Canada's national circumstances,	Not resolved. The ERT notes that although Canada indicated during the previous review that it would update the N_2O EF related to MSW incineration in the next

ID[a]	*Issue classification[a]*	*Recommendation made in previous review report*	*ERT assessment and rationale*
	Accuracy	or update the EF to that provided in the 2006 IPCC Guidelines.	submission, it still uses the same EF from the Revised 1996 IPCC Guidelines without providing any additional information to justify its use.
W.7	5.D.1 Domestic wastewater – CH_4 and N_2O (W.17, 2016) (W.12, 2015) (82, 2014) Accuracy	Justify the assumption that there is 100 per cent efficient combustion and flaring at anaerobic wastewater treatment systems servicing urban municipalities.	Not resolved. Canada has not included any information in the NIR to justify the assumption that there is 100 per cent efficient combustion and flaring at anaerobic wastewater treatment systems.
W.8	5.D.1 Domestic wastewater – CH_4 (W.19, 2016) (W.23, 2015) Accuracy	Investigate whether the BOD of 0.05 kg/person/day used in the estimates for municipal wastewater treatment (which is different from the default value provided in the 2006 IPCC Guidelines of 0.06 kg/person/day) could be used in the Party's inventory as a country-specific value.	Resolved. Canada has used the default value for the BOD provided in the 2006 IPCC Guidelines (0.06 kg BOD/person/day).

[a] References in parentheses are to the paragraph(s) and the year(s) of the previous review report(s) where the issue was raised. Issues are identified in accordance with paragraphs 80–83 of the UNFCCC review guidelines and classified as per paragraph 81 of the same guidelines.

IV. Issues identified in three successive reviews and not addressed by the Party

7. In accordance with paragraph 83 of the UNFCCC review guidelines, the ERT noted that the issues included in table 4 have been identified in three successive reviews, including the review of the 2017 inventory submission of Canada, and have not been addressed by the Party.

Table 4
Issues identified in three successive reviews and not addressed by Canada

ID[a]	*Previous recommendation for the issue identified*	*Number of successive reviews issue not addressed*
General		
	No such general issues were identified	
Energy		
E.1	Take steps to ensure that the conversion of volumes of natural gas to energy units is completed appropriately for both marketable and non-marketable natural gas. Document the progress on efforts in the improvement plan and in the NIR	4 (2014–2017)
E.2	Develop a plan that provides a timeline for updating the carbon content factors regularly, prioritizing fuels used in large quantities within Canada, as well as fuels with high carbon content variabilities	3 (2015–2017)
E.8	Report the CO_2, CH_4 and N_2O emissions from the purchased fuels used in manufacture of solid fuels and other energy industries in that category	3 (2015–2017)

ID	*Previous recommendation for the issue identified*	*Number of successive reviews issue not addressed*
E.12	Provide an explanation in the NIR that the low IEF for gasoline reported in the CRF tables is attributed to the outdated GCVs used to convert the AD and EF from physical to energy units	3 (2015–2017)
E.13	Carry out the analysis to evaluate the opportunities to repeat portions of the McCann (2000) study to investigate the evolution and current applicability of the final applied EF, and document progress made in this regard in the improvement plan and in the NIR	4 (2014–2017)
E.14	Either estimate and include in the inventory CO_2, CH_4 and N_2O emissions from steam trains, or provide a justification in the NIR, consistent with the UNFCCC Annex I inventory reporting guidelines, that these emissions are considered insignificant	3 (2015–2017)
E.17	Report the CO_2 emissions from underground mines as "NA" and indicate in the NIR that no CO_2 emissions associated with flaring and drainage systems of underground mines occur in the country	3 (2015–2017)
E.18	Transparently explain in the NIR the assumptions, country-specific surface mines data, parameters and information from the national studies that were used, in order to justify the accuracy of the emission calculations. If this information is not available, then, as a first step, for emissions from surface mines which were estimated by using the adjusted Coal Industry Advisory Board methodology, apply the respective tier 1 method from the 2006 IPCC Guidelines, and afterwards plan and implement the application of a tier 2/tier 3 method that will be transparently described in the NIR, provided that it is developed in a manner consistent with the 2006 IPCC Guidelines and following the provisions of paragraph 41 of the UNFCCC Annex I inventory reporting guidelines	3 (2015–2017)
E.19	Verify that the emissions from all coke oven gas both consumed and flared at the four integrated iron and steel plants are included in the inventory and report accordingly in the NIR	3 (2015–2017)
E.22	Continue to explore ways to review and update the bitumen model to capture industry changes and document progress on this in the improvement plan and in the NIR	4 (2014–2017)
IPPU		
I.2	Include CO_2 emissions from ceramics production in the inventory or demonstrate that the emissions are insignificant, as defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines	3 (2015–2017)
I.5	Include CO_2 and CH_4 emissions from ethylene oxide production in the inventory or demonstrate that the emissions are insignificant, as defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines	3 (2015–2017)
I.7	Include the allocation of non-energy use of other reductants identified in this category in the improvement plan and implement steps to further disaggregate the energy statistics and other (industrial processes) category	4 (2014–2017)

ID[a]	*Previous recommendation for the issue identified*	*Number of successive reviews issue not addressed*
I.12	Implement the scheduled improvements for this category, reporting on progress in future inventory submissions, and continue the improvements necessary to document the methods and sources of AD and EFs in the NIR	7 (2011–2017)
Agriculture		
A.6	Report direct N_2O emissions from sewage sludge and other organic fertilizers applied to soils	3 (2015–2017)
LULUCF		
L.1	Improve the completeness of reporting of the pools in all mandatory categories currently reported as "NE" and include a description on how the notation keys have been used	5 (2013–2017)
L.2	Improve the completeness for representing land areas in the LULUCF sector by amending the reporting (both the land-use change matrix and the estimates for category-specific emissions/removals in the CRF tables)	3 (2015–2017)
L.8	Provide additional information on why using zero for annual area conversions to forest land for the period 2009–2013 is considered reasonable compared with other alternative ways to construct the time series. Continue with efforts to acquire the missing AD for land converted to forest land	3 (2015–2017)
L.10	Estimate all the direct N_2O emissions as well as the associated indirect N_2O emissions from nitrogen mineralization/immobilization associated with loss/gain of soil organic matter. Until the estimation is implemented, provide information on the planned improvement and assessment of the quantitative impact of this missing category in accordance with the provisions in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines	3 (2015–2107)
L.13	Include data for 1900–1940 for estimating emissions from the category harvested wood products, as part of the improvement work in relation to the category, and consider how the uncertainty may be affected	3 (2015–2017)
Waste		
W.5	Report all emissions related to energy recovery in the energy sector	7 (2011–2017)
W.6	Either justify the continued use of the default EF from the Revised 1996 IPCC Guidelines as appropriate to Canada's national circumstances, or update the EF to that provided in the 2006 IPCC Guidelines	3 (2015–2017)
W.7	Justify the assumption that there is 100 per cent efficient combustion and flaring at anaerobic wastewater treatment systems servicing urban municipalities	4 (2014–2017)

V. Additional findings made during the 2017 individual inventory review

8. Table 5 contains findings made by the ERT during the individual review of the 2017 inventory submission of Canada that are additional to those identified in table 3.

Table 5
Additional findings made during the 2017 individual review of the inventory submission of Canada

ID[a]	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue?[b] If yes, classify by type*
General			
G.4	CRF tables	In the CRF tables for sectoral reports for all the sectors, Canada reports emissions of all precursor gases other than CH_4 (CO, NO_x, NMVOC and SO_2) as "NE", "NA", "NO" and/or "IE", with a comment referring to annex 7 to the NIR. Annex 7 contains an outdated link to the website of Environment and Climate Change Canada with the statement that information regarding precursor gases such as CO, NO_x, NMVOC and SO_2 should be provided in the NIR. During the review, the Party stated that the 2006 IPCC Guidelines are not clear on the distinction between "indirect" and "precursor" emissions. The Party further stated that it does not wish to report CO, NO_x, NMVOC and SO_2 emissions in more than one inventory. The ERT notes in this regard that Canada reports its inventory of emissions of precursor gases under the UNECE Convention on Long-range Transboundary Air Pollution. However, it believes that it is misleading to report NO_x, CO, NMVOC and SO_2 emissions as "IE" because these precursor gases are not included in any of the categories in the GHG inventory reported under the Convention. The ERT encourages Canada to report data on emissions of precursor gases (as reported under UNECE) in the appropriate CRF tables under the relevant sectors. The ERT further encourages the Party to provide numerical values for emissions of precursor gases and indirect emissions for all relevant sectors and gases and to document the methodology used to calculate the indirect CO_2 emissions in the NIR.	Not an issue
G.5	QA/QC and verification	Canada has presented a comprehensive list of planned inventory improvements in the NIR (part 1, chapter 8.3). The ERT notes that many planned improvements relate to issues categorized as "addressing" in the previous review reports. Although the summary of Canada's inventory improvement plan presented in the NIR (part 1, table A8-4) contains a column on "progress update", it does not provide specific details on the timeline for the planned improvements. During the review, Canada noted that the provision of timelines for planned improvements exceeds the requirements of the UNFCCC Annex I inventory reporting guidelines. The ERT encourages the Party to include timelines for implementation of the planned improvements, particularly for those relating to recommendations from the previous review reports.	Not an issue
G.6	QA/QC and verification	According to the NIR (part 1, section 1.3.4), Canada performs annual verification activities for the GHG inventory, including bottom-up comparisons based on the GHG emissions reporting programme and comparison of Canada's GHG inventory with other independently compiled inventories, literature sources or direct source- testing results. The ERT notes, however, that the NIR does not provide specific information on these verification activities. During the review, Canada provided a reference to the website of the Facility Greenhouse Gas Emissions Reporting Program for verification activities for the energy sector that provides a very general comparison of facility-reported emissions without including any specific information regarding the verification activity and its outcome. Canada also did not provide any further information on other verification activities mentioned above.	Not an issue

ID[a]	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue[b]? If yes, classify by type*
		The ERT encourages Canada to provide in the NIR specific information on its verification activities, including: their findings and outcomes; the data sources used for verification activities; and the results of comparing the GHG inventory with other independently compiled inventories, literature sources or direct source-testing results.	
Energy			
E.23	Feedstocks, reductants and other non-energy use of fuels – liquid fuels – CO_2	Canada has reported the fuel quantity (column D of CRF table 1.A(d)) and CO_2 emissions from non-energy use (column I of CRF table 1.A(d)) of LPG as "NO". However, as indicated in column J of the same table, CO_2 emissions from non-energy use of LPG are reported under "Chemical industry, petrochemical production – other". During the review, Canada explained that all non-energy use of LPG (propane and butane) was reported under NGL, since the national statistical agency was unable to differentiate propane and butane from the NGL and LPG streams. Canada mentioned that it will use "IE" for LPG in the relevant columns in CRF table 1.A(d) in the future. The ERT recommends that Canada report non-energy use of LPGs using the correct notation key "IE" in CRF table 1.A(d).	Yes. Comparability
E.24	1. General (energy sector) – all fuels – CO_2, CH_4 and N_2O	Canada recalculated GHG emissions from categories 1.A.2 (manufacturing industries and construction), 1.A.3 (transport) and 1.A.4 (other sectors). Owing to the recalculation, emissions of CO_2, CH_4 and N_2O in 1990 for category 1.A.3 decreased by 13.9 per cent, 20.1 per cent and 27.2 per cent, respectively, whereas emissions of CO_2, CH_4 and N_2O in 2014 decreased by 12.7 per cent, 24.4 per cent and 44.9 per cent, respectively. On the other hand, emissions of CO_2, CH_4 and N_2O in 1990 reported under category 1.A.2 increased by 14.0 per cent, 31.9 per cent and 168.1 per cent, respectively, while emissions of CO_2, CH_4 and N_2O in 2014 reported under the same category increased by 11.3 per cent, 25.9 per cent and 132.4 per cent, respectively. Similarly, emissions of CO_2, CH_4 and N_2O in 1990 reported under category 1.A.4 increased by 15.4 per cent, 4.8 per cent and 135.5 per cent, while emissions of CO_2, CH_4 and N_2O in 2014 reported under the same category increased by 17.2 per cent 6.5 per cent and 161.1 per cent, respectively. The ERT noted that the explanation of the recalculations of these categories provided in the NIR (part 1, sections 3.2.5.5, 3.2.6.5 and 3.2.7.5) was not sufficiently transparent with regard to the reasons for the recalculations. During the review, Canada explained that the main reason for the recalculations was that emissions from off-road transportation, previously reported under 1.A.3.e.ii (other transportation/other) were reallocated to 1.A.2 and 1.A.4 to be consistent with the CRF reporting requirements. While commending Canada's efforts to improve the reporting, the ERT also noted that this information was not included in the NIR. The ERT recommends that Canada provide a comprehensive explanation of any recalculations performed in categories 1.A.2, 1.A.3 and 1.A.4.	Yes. Transparency
E.25	1.A. Fuel combustion – sectoral approach – solid fuels – CO_2	Canada updated the EFs for CO_2 emissions from coal combustion based on the study conducted by Environment and Climate Change Canada and reported the updated EFs in the NIR (part 2, table A6-8). The ERT noted that the updated EF for foreign sub-bituminous coal (1,425 kg CO_2/t) was 18 per cent lower than the value reported in the previous NIR (1,743 kg CO_2/t), while the EFs for other types of coal changed by only −1 per cent to +1 per cent.	Yes. Accuracy

ID[a]	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue?[a] If yes, classify by type
		During the review, Canada stated that a further review of the study had identified that a few measurement results were misinterpreted in the original study. Canada also explained that a new EF for foreign sub-bituminous coal of between 1,739 and 1,865 kg CO_2/t had been derived by correcting this misinterpretation and this corrected value will be incorporated in the 2018 inventory submission. The ERT recommends that Canada use the correct value for the EF for foreign sub-bituminous coal of between 1,739 and 1,865 kg CO_2/t.	
E.26	1.A.3 Transport – liquid fuels – CO_2	The ERT noted that Canada did not explain how it estimated and reported CO_2 emissions from lubricants combusted in two-stroke engines in the NIR. During the review, Canada provided the explanation that it did not calculate emissions from lubricants combusted in two-stroke engines separately and these emissions were included in the IPPU sector for non-energy use of fuel. The ERT also noted that Canada applied a single oxidation factor (50 per cent) to the entire amount of lubricants oxidized during use. The ERT considers that this may cause a potential underestimation of CO_2 emissions because lubricants used in two-stroke engines are usually fully combusted. The ERT recommends that Canada estimate CO_2 emissions from lubricants combusted in two-stroke engines separately using appropriate oxidation factors and report them in the energy sector.	Yes. Accuracy
E.27	1.A.3 Transport – liquid fuels – CO_2, CH_4 and N_2O	Canada updated estimation methodologies for the road transportation and off-road transportation categories and started to use the MOVES (Motor Vehicle Emissions Simulator) model and the NONROAD (Nonroad Engines, Equipment and Vehicles) model to disaggregate motor gasoline and diesel consumption into each vehicle and equipment type. The ERT noted that the NIR (part 2, section A3.1.4.2.1) did not provide a transparent description of the overall methodology used in these models. The ERT further noted that the NIR did not include information on the verification of the MOVES and NONROAD models in the NIR. During the review, Canada explained that it was in the process of developing more detailed methodological documentation on these models and provided its draft to the ERT. The ERT welcomes this ongoing work. Canada also provided a document giving the background information on the implementation of these two models, which, however, did not provide sufficient information on the verification of the models. The ERT recommends that Canada finalize the update of the methodological documentation on the MOVES and NONROAD models and include a summary of the documentation in the NIR. The ERT further recommends that Canada provide information on the verification of the MOVES and NONROAD models (e.g. comparison of the values estimated by the models to data from other sources) in the NIR, in accordance with paragraph 41 of the UNFCCC Annex I inventory reporting guidelines.	Yes. Transparency
E.28	1.A.3.d Domestic navigation – liquid fuels – CO_2, CH_4 and N_2O	Canada reported in its NIR that the fuel sold to foreign marine vessels is assumed to be used only for international travel and the associated emissions are reported separately as a memo item under international bunkers, while the fuel sold to Canadian vessels is assumed to be used for domestic navigation. Canada, however, provided the information in the NIR (part 2, section A3.1.4.2.3) that some Canadian vessels are also engaged in international marine travel. Canada also mentioned in the NIR that although it has considered accurate disaggregation of fuel	Not an issue

ID[a]	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue[b]? If yes, classify by type
		consumption between domestic and international navigation (part 1, section 3.2.6.6), it has not been possible so far owing to a lack of comprehensive data (part 2, section A3.1.4.2.3). During the review, Canada confirmed that it has undertaken a project aimed at improving the fuel allocation between domestic and international navigation, but being at a preliminary stage, it has not been referenced in the NIR. The ERT encourages Canada to accurately disaggregate fuel consumption between domestic and international navigation.	
E.29	1.B.1.a Coal mining and handling – solid fuels – CH_4	For estimating the fugitive emissions from surface mines for 16 out of the 23 coal mines located in eastern Canada, Canada applies the Coal Industry Advisory Board methodology, which is detailed in the industry report. However, noting that it cannot assess the adjusted Coal Industry Advisory Board methodology and assumptions used by Canada owing to a lack of transparent information on the methodology in the NIR, the ERT made a recommendation in the 2015 inventory review report that Canada transparently explain in the NIR the assumptions, country-specific surface mines data, parameters and information from the national studies that were used, in order to justify the accuracy of the emission calculations. The ERT further recommended that, if this information were not available, then, as a first step, for emissions from surface mines which were estimated using the adjusted Coal Industry Advisory Board methodology, Canada apply the respective tier 1 method from the 2006 IPCC Guidelines, and afterwards to plan and implement the application of a tier 2/tier 3 method that would be transparently described in the NIR, provided that it is developed in a manner consistent with the 2006 IPCC Guidelines and following the provisions of paragraph 41 of the UNFCCC Annex I inventory reporting guidelines. Since Canada neither provided the information on the Coal Industry Advisory Board methodology in the NIR nor revised the methodology as requested by the ERT, the ERT maintained this finding while noting the explanation regarding the Coal Industry Advisory Board methodology provided by Canada (see issue ID# E.18 in table 3). The ERT, however, notes that in the light of the explanation provided by Canada, this issue may be considered resolved if the explanation regarding the Coal Industry Advisory Board methodology provided to the ERT is included in the NIR. The ERT recommends that Canada include in the NIR the explanation regarding the Coal Industry Advisory Board methodology provided to the ERT during the 2016 and 2017 reviews.	Yes. Transparency
E.30	1.C CO_2 transport and storage – all fuels – CO_2	As stated in the NIR (part 1, section 3.5.2), Canada has two CO_2 EOR projects in operation. Canada reports the amount of CO_2 captured and imported and fugitive CO_2 emissions from CO_2 transport through pipelines under these CO_2 EOR projects in CRF table 1.C. According to the annotation (6) to CRF table 1.C, the difference between the sum of the total amounts of CO_2 corresponding to: exports for storage; injection at storage sites; and leakage from transport, injection and storage (cell D23 of CRF table 1.C) and the sum of the total amounts of CO_2 captured for storage and imported (cell D19 of CRF table 1.C) ideally should be zero. However, the ERT notes that the values of the above-mentioned difference in CRF table 1.C (cell D24) are not zero from 2000 to 2015, mainly because fugitive CO_2 emissions associated with these CO_2 EOR projects (other than the emissions from pipeline CO_2 transport) are included in the categories energy industries (1.A.1) and oil and natural gas and other emissions from energy production (1.B.2), and are thus not reported under the category CO_2 transport and storage (1.C).	Yes. Transparency

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue?[a] If yes, classify by type
		Although this approach to the allocation of emissions is in accordance with the 2006 IPCC Guidelines, the ERT considers that it makes it difficult to check the mass balance among the amounts of CO_2 captured, imported and stored and fugitive CO_2 emissions. During the review, Canada explained that any fugitive emissions associated with EOR were currently included in estimates for the oil and gas industry and thus cannot be disaggregated. Canada also stated that there was an ongoing discussion about obtaining information that would provide more detailed information on carbon dioxide capture and storage in Canada. The ERT welcomes this ongoing work. The ERT recommends that Canada provide transparent information on the subcategories under which the fugitive CO_2 emissions from the two CO_2 EOR projects are reported and how the Party ensures comprehensive coverage of fugitive CO_2 emissions from these projects in the NIR.	
IPPU			
I.19	2.B.1 Ammonia production – CO_2	According to the NIR, the ammonia-to-feed fuel conversion factors were developed from the feed fuel requirement for ammonia production based on the information collected by Environment Canada through a voluntary data submission process from the fertilizer industry in the period 2005–2009, while an average value was used for the plants that did not report. The ERT, however, noted that the NIR did not provide transparent information on the percentage of plants that provided information and the variability of the ammonia-to-feed fuel factor in the survey data. Canada provided this information in response to a question from the ERT during the review. The ERT recommends that Canada include information from the fertilizer industry survey that was undertaken in the period 2005–2009 on the number of plants that provided information on feed fuel requirement for ammonia production and the variability of the ammonia-to-feed-fuel factor.	Yes. Transparency
I.20	2.B.1 Ammonia production – CO_2	According to the UNFCCC Annex I inventory reporting guidelines (see footnote 5 to CRF table 2(I).A-Hs1), to ensure that double counting does not occur, if CO_2 from ammonia production is recovered for downstream use and is excluded from the reporting in category 2.B.1, Parties should report supporting information on the products and the purposes for which the CO_2 is used in the NIR. Parties should report related CO_2 emissions from these products and significant uses, in the relevant categories in the inventory, if these emissions occur within the borders of the Party concerned. Parties should also provide an overview in the NIR explaining in which other categories of the GHG inventory CO_2 emissions from significant uses of urea are reported. The ERT noted that Canada did not provide this information in the NIR. During the review, Canada indicated that the only recovery for downstream use is for urea production and that emissions from use of urea as fertilizer are included in the agriculture sector as per the 2006 IPCC Guidelines. The ERT recommends that Canada provide information to enable an evaluation of whether all CO_2 emissions from significant uses of urea are included in the inventory, including by providing an overview table in the NIR listing the use(s) of the CO_2 emissions recovered from ammonia production, by the category in which they are reported in the GHG inventory.	Yes. Transparency

ID[a]	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue?[b] If yes, classify by type*
I.21	2.B.2 Nitric acid production – N_2O	Canada has reported in the NIR that it has used a mix of tier 1, 2 and 3 methods to estimate N_2O emissions from nitric acid production, with a predominance of tier 2 methods involving the application of plant-level production values to EFs corresponding to different production technologies. The NIR (part 1, table 4-5) provides the values of EFs by type of production process and emission control technologies. The ERT, however, noted that the NIR does not provide transparent information on the exact methodology followed in different years of the time series, including specifying the plants whose emissions are estimated using the different methodological tiers. The ERT further noted that the NIR also does not provide transparent information on how the EFs provided in the NIR are used for the estimation of emissions, including the years and number of plants for which they are used. The ERT also noted that the sources of data for the EFs are referenced as personal communication from 1992 and the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. During the review, Canada indicated that it estimated emissions for 2015 for all five plants using a tier 2 methodology by multiplying plant-specific production data by country-specific EFs for the plant type. It also explained that the EFs provided in the NIR were used for almost all years and all plants, with the exception of two plants where plant-specific EFs were used for some years (2000–2004 and 1990–2004 for the two plants, respectively). Canada further stated that a 2006 study had found that the EFs used were appropriate to Canadian conditions and indicated that it would include more transparent information on the work done on EFs used for nitric acid production in the next submission. The ERT recommends that Canada include transparent information on the methodological tier used for the estimation of nitric acid production for each plant in the NIR. The ERT also recommends that, as provided during the review, Canada provide more transparent information on the EFs used for nitric acid production in the NIR, including how EFs provided in the NIR are used for the estimation of emissions, and the years and number of plants for which they are used.	Yes. Transparency
I.22	2.C.3 Aluminium production – CO_2, PFCs and SF_6	Canada stated in the NIR that depending upon data availability, process-related emissions from aluminium production have been estimated using tier 1, 2 and 3 methods across the time series. However, since 2010, most process-related emissions of CO_2, PFCs and SF_6 reported by facilities have been estimated using tier 3 methods. During the review, Canada explained that in 2015, all plants were reporting their process-related emissions from aluminium production using tier 3 methods and indicated that this information would be added to the NIR in the next submission. The ERT recommends that Canada include information on the shares of process-related emissions from aluminium production estimated using different methodological tiers across the time series in the NIR.	Yes. Transparency
I.23	2.C.4 Magnesium production – SF_6	The ERT noted that although the NIR mentions that magnesium casting facilities in operation released nearly 200 kt CO_2 eq SF_6 emissions in 2015, Canada did not report these emissions in the CRF tables. During the review, Canada explained that these emissions were reported under category 2.C.7 (other metal production) and noted some issues in such reporting, including unavailability of data on the amount of magnesium casted and primary production and casting of magnesium taking place in two different facilities. The ERT, however, notes that as per the 2006 IPCC Guidelines, magnesium casting should be considered part of magnesium production (see chapter	Yes. Comparability

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue[a] If yes, classify by type*
		4.5, volume 3). The ERT recommends that Canada reallocate emissions from magnesium casting from category 2.C.7 (other metal production) to 2.C.4 (magnesium production).	
I.24	2.D Non-energy products from fuels and solvents use – CO_2	The ERT noted that the emissions reported from the subcategory other in category 2.D.3 (non-energy products from fuels and solvent use) are high and thus constitute a key category according to the 2006 IPCC Guidelines (chapter 1.4, volume 3), which provide guidance on good practice for reporting documentation related to the reporting and completeness of the estimates of non-energy use of fuels. The ERT also noted that little information was available in the NIR on the assumptions made in estimating emissions from this category. During the review, Canada provided the ERT with the calculation sheet for 2015 and informed the ERT that it has followed the good practice in the 2006 IPCC Guidelines to the extent allowed by data availability. The ERT noted that according to the calculation spreadsheet, in category 2.D.3 by far the biggest source of emissions is other products, accounting for almost 60 per cent of the emissions from the category. Canada informed the ERT that this category includes waxes, paraffin and unfinished products (i.e. items that cannot be identified in end-product terms). The ERT recommends that Canada investigate whether the subcategory other products corresponds to paraffin wax use as defined in the 2006 IPCC Guidelines and, if that is the case, reallocate the emissions from category 2.D.3 to category 2.D.2 (paraffin wax use) and estimate emissions using the default oxidized during use factor from the 2006 IPCC Guidelines rather than the default carbon storage factor from the Revised 1996 IPCC Guidelines. If the subcategory other products does not correspond to paraffin wax use, then the ERT recommends that Canada explore whether the data on paraffin wax use (as defined in the 2006 IPCC Guidelines) can be identified within the AD for subcategory 2.D.3 to allow separate reporting of the associated emissions. The ERT further recommends that Canada provide a transparent description in the NIR of the assumptions and approach used in the reporting, ensuring the completeness of the reporting of CO_2 emissions from category 2.D.3.	Yes. Accuracy
I.25	2.F. Product uses as substitutes for ozone-depleting substances – PFCs	The ERT noted that Canada has estimated the emissions of PFCs from category 2.F (product uses as substitutes for ozone-depleting substances) using the methodologies provided in the Revised 1996 IPCC Guidelines rather than those in the 2006 IPCC Guidelines. During the review, Canada explained that although it has started the implementation of the 2006 IPCC Guidelines for this category, it could not be completed for the 2017 inventory submission. The Party also indicated that it would estimate all PFC emissions in category 2.F using the 2006 IPCC Guidelines, making appropriate revisions to the NIR in the next submission. The ERT recommends that Canada estimate all PFC emissions in category 2.F using the 2006 IPCC Guidelines, making appropriate revisions to the NIR to reflect the use of the updated methodologies.	Yes. Adherence to the UNFCCC Annex I inventory reporting guidelines
I.26	2.G.4 Other (other product manufacture and use) –	Canada includes emissions from urea-based catalysts in the subcategory other in category 2.G.4 (other product manufacture and use) and not in subcategory other in category 2.D.3 (non-energy products from fuels and solvent use) as prescribed by the UNFCCC Annex I inventory reporting guidelines (see footnote 6 to CRF table 2(I).A-Hs2). During the review, Canada indicated that it would reallocate the emissions to the appropriate category in the	Yes. Comparability

ID[a]	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue?[a] If yes, classify by type
	CO_2	2018 inventory submission. The ERT recommends that Canada reallocate emissions from urea-based catalysts from category 2.G.4 to category 2.D.3 in the next submission.	
Agriculture			
A.11	3. General (agriculture)	The ERT noted that Canada provided the incorrect references to some sources of data in the NIR. For example, the source of the nitrogen excretion rates for dairy and other cattle in the NIR (part 2, footnote 1 to table A3-41) has been provided as table 10.10 (volume 4) in the 2006 IPCC Guidelines, whereas the correct reference should be to table 10.19 (volume 4) in the 2006 IPCC Guidelines. Similarly, the NIR (part 2, footnote 1 to table A6-2) incorrectly references the source of the EF for CH_4 emissions from manure management for mules and asses as table 10.15 (volume 4) of the 2006 IPCC Guidelines instead of table 10.16 (volume 4) of the 2006 IPCC Guidelines. During the review, Canada acknowledged the errors and informed the ERT that it would correct them in the next submission. The ERT recommends that Canada provide the correct references to the sources of nitrogen excretion rates for dairy and other cattle and of the EFs for CH_4 emissions from manure management for mules and asses in the NIR.	Yes. Transparency
A.12	3.B.4 Other livestock – CH_4	Canada has estimated CH_4 emissions from manure management from minor livestock categories (e.g. mules and asses, wild boars and llamas and alpacas) using logical proxies based on similarities in species and production practices between horses and mules and asses, swine and wild boars, and sheep and llamas and alpacas (part 2, section A3.4.3.6). The ERT noted that the Party has not provided an explanation or background documentation for this assumption regarding proxies or for the derivation of the EFs using this approach in the NIR. During the review, Canada provided the explanation that in cases where data are unavailable for minor livestock categories, it uses data from other livestock categories with similarities in species and/or in production practices. In the case of mules and asses, although the default CH_4 EF was available in the 2006 IPCC Guidelines, since the proportion of manure allocated to each AWMS required for N_2O estimates was unknown, the EF values for horses were used as a proxy. The ERT, however, notes that it would greatly improve the transparency of the submission if Canada provided a detailed explanation and background documentation on the assumption of the proxies together with information on the derivation of the EFs for CH_4 from manure management. The ERT recommends that Canada provide a more detailed explanation and/or background documentation on the assumption regarding proxies as well as on the derivation of the EFs for CH_4 emissions from manure management in the NIR.	Yes. Transparency
A.13	3.B.4 Other livestock – CH_4	Canada has assumed the same mean VS values for llamas and alpacas as sheep and lambs (part 2, footnote 1, table A3-33). Canada mentioned in the documentation box for CRF table 3.B(a)s1 ("3.B.1/2015: 3.B.1.4 Camels") that the camels category includes camelids, which in Canada consist of llamas and alpacas. However, the ERT noted that in CRF table 3.B(a)s1, the value of VS reported for sheep and lambs (0.61) is different from that for camels (0.71). Thus, there is an inconsistency between the NIR and the CRF tables. During the review, the Party explained	Yes. Transparency

ID[a]	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue?[b] If yes, classify by type
		that, as indicated in the NIR (part 2, footnote 1 to table A3-33), although llamas and alpacas are assumed to have the same VS values as sheep at the provincial level, the VS values for llamas and alpacas and sheep and lambs presented in the NIR and the CRF tables are national values calculated by weighting the provincial VS values by the population of animals in each province. The national VS values for these two livestock categories are thus different owing to their different populations in different provinces. The ERT recommends that Canada provide a more detailed explanation in the NIR that the reason for the apparent inconsistency between the values of VS for llamas and alpacas compared to sheep and lambs reported in the NIR and the CRF tables (although the Party assumes the same mean value for VS for all these animals) is owing to the fact that the values in the NIR and CRF tables are national values calculated by weighting the provincial VS values by the population of animals in each province.	
A.14	3.B.4 Other livestock – N_2O	Canada reported 17.22 kg N/head/year as the nitrogen excretion rate for camels in CRF table 3.B(b). However, the ERT calculated this value as 15.58 kg N/head/year using the nitrogen excretion rate for camels for North America provided in the 2006 IPCC Guidelines (0.38 kg N/1,000 kg animal mass/day) together with the typical animal mass for camels reported in CRF table 3.B(b) (112.30 kg/animal). During the review, Canada explained that because the CRF Reporter did not allow for the creation of a separate livestock category for llamas and alpacas, it had to report the emissions from llamas and alpacas under camels by including a note in the documentation box in the CRF table to explain that the category camels represents camelids, which consists of llamas and alpacas. However, Canada noted that based on similarities in production practices, the calculation of nitrogen excretion for llamas and alpacas uses the default nitrogen excretion rate for sheep (0.42 kg N/1,000 kg animal mass/day), as both are predominantly raised for the production of wool in Canada. The ERT recommends that Canada explain in the NIR that the calculated nitrogen excretion rate for camels in CRF table 3.B(b) is different from the default value for camels in the 2006 IPCC Guidelines because it reflects the nitrogen excretion rate from llamas and alpacas (which is assumed to have the same default nitrogen excretion rate as sheep).	Yes. Transparency
A.15	3.B.5 Indirect N_2O emissions – N_2O	Canada has estimated indirect N_2O emissions from manure management separately for nitrogen volatilization and leaching reportedly using the tier 1 methodology from the 2006 IPCC Guidelines by adjusting the fractions of manure nitrogen subject to losses because of nitrogen leaching and volatilization during storage by animal type and manure management system according to the default values provided in the 2006 IPCC Guidelines. The ERT, however, noted that the 2006 IPCC Guidelines do not provide a tier 1 methodology for estimating indirect N_2O emissions from leaching and run-off from manure management, but they do provide a tier 2 methodology (volume 4, chapter 10, p.10.56) that could be used if country-specific information on the fraction of nitrogen loss due to leaching and run-off from manure management systems is available. Therefore, the estimation of nitrogen losses from leaching and run-off from manure management should be considered part of a tier 2 or tier 3 method. During the review, Canada confirmed that it does not currently have country-specific estimates of leaching from manure storage, including the amount of manure held in contained or covered systems or the amount of manure nitrogen lost through leaching and run-off. Canada stated that although the 2006 IPCC Guidelines do not prescribe a clearly	Yes. Accuracy

ID[a]	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue[b]? If yes, classify by type
		defined tier 1 approach to estimate nitrogen leaching from manure management systems, they provide values for total nitrogen loss from manure management systems (volume 4, chapter 10, table 10.23) and make reference specifically to leaching and run-off as being a source of nitrogen loss where appropriate. The Party further explained that much of the solid manure in Canada has historically been managed in manure packs and piles that are not covered or contained and as such may be prone to leaching and run-off. Canada has thus used the difference between the tier 1 values of total nitrogen loss and nitrogen volatilized for solid systems as a default value for the loss due to leaching and run-off based on the assumption that nitrogen losses due to leaching and run-off and those due to volatilization account for the entire amount of nitrogen losses from confined manure management systems. The ERT, however, notes that this assumption has not been supported by necessary documentation such as research studies. The ERT further notes that the total nitrogen loss from manure management systems given in the 2006 IPCC Guidelines includes nitrogen losses from both direct and indirect pathways. The ERT thus considers that the indirect N_2O emissions from run-off and leaching can be estimated only when a country can develop the value of $Frac_{leachMS}$ based on country-specific data on nitrogen run-off and leaching from manure management systems. The ERT, therefore, recommends that Canada estimate indirect N_2O emissions from manure management systems due to leaching and run-off by using a tier 2 approach and by developing the value of $Frac_{leachMS}$ based on country-specific data on nitrogen run-off and leaching from manure management systems.	
A.16	3.B.5 Indirect N_2O emissions – N_2O	The ERT noted the following transcription errors in the reporting of information related to indirect N_2O emissions in the NIR: 1. The description of $N_{t,AWMS}$, the percentage of manure nitrogen handled by each manure management system in a province under equation A3-27 (part 2, p.112), incorrectly refers to table A3-38 (part 2, p.105), which is in fact related to the EFs to estimate CH_4 emissions from manure management for cattle subcategories from 1990 to 2015. The correct reference should be to table A3-37 (part 2, p.104); 2. The description of $N_{EX,T}$, the nitrogen excretion rate for the animal category or subcategory under equation A3-27 (part 2, p.112), incorrectly refers to table A3-43 as the source for the values for non-cattle, which is in fact related to the total N, NH_3 and NO_x losses associated with various livestock and manure management systems. The correct reference should be to table A3-41 (part 2, p.111); 3. The description of $Frac_{LeachMS(T,AWMS)}$, the fraction of managed manure nitrogen losses for livestock category T due to leaching and run-off during solid and liquid storage of manure under equation A3-27 (part 2, p.112) incorrectly refers to table A3-44 (part 2, p.119), which is in fact related to the emissions of N_2O from beef urine and dung on pasture in western Canada. The correct reference should be to table A3-43 (part 2, p.116). During the review, Canada acknowledged these transcription errors and informed the ERT of its plans to correct them in the next submission. The ERT recommends that Canada use the correct table numbers in the descriptions of various parameters in equation A3-27 (part 2, p.112) in the NIR and improve the QA/QC procedures to prevent the occurrence of such	Yes. Transparency

ID[a]	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue?[b] If yes, classify by type
		errors.	
A.17	3.H Urea application – CO_2	The ERT noted significant inter-annual variability in CO_2 emissions from urea application across the following years in the time series: 1993–1994 (11.5 per cent), 2006–2007 (23.6 per cent), 2011–2012 (15.2 per cent), 2012–2013 (15.3 per cent) and 2013–2014 (–5.4 per cent). During the review, Canada explained that CO_2 emissions from urea application depend on the fraction of urea in total fertilizer sales, and that owing to the changes in the national crop mix and farm economies from year to year that influence fertilizer demand and use in the field, there were significant changes in the total fertilizer sold and applied in Canada in the years noted by the ERT, which led to the large inter-annual variations in the CO_2 emissions from urea application in those years. The ERT recommends that Canada provide transparent information to substantiate the significant inter-annual variability in the CO_2 emissions from urea application for the years 1993–1994, 2006–2007, 2011–2012, 2012–2013 and 2013–2014 in the NIR.	Yes. Transparency
LULUCF			
L.15	Land representation – CO_2, CH_4 and N_2O	Canada has performed recalculations resulting in very large changes in removals by sinks. The ERT noted that as stated in the NIR (part 1, p.196), while most of the recalculations are the result of improved estimates of anthropogenic emissions and removals in forest land, a few less significant recalculations are owing to changes in areas assigned to land-use categories, in particular forest conversions. The ERT noted that the total land area in the land-use matrix in CRF table 4.1 is different for some years and the total land area at the end of the inventory year is not the same in the next inventory year (with differences of nearly 30–40 kha) in some cases, for example in 1994–1996, 2003 and 2007–2008 (see issue ID# L.4 in table 3). During the review, Canada noted that the inconsistencies in total land area reported in CRF table 4.1 are owing to an inadvertent error made when calculating the areas of managed and unmanaged land in land remaining in the same land-use categories. The ERT recommends that Canada correct the error in the reporting of the total land area of Canada in the land-use matrix reported in CRF table 4.1 that is owing to the inadvertent error made when calculating the areas of managed and unmanaged land in land remaining in the same land-use categories.	Yes. Transparency
L.16	4.A Forest land – CO_2	Canada did not estimate the GHG emissions from drainage of organic soils for forestry (also see issue ID# L.9 in table 3). During the review, Canada informed the ERT that it has recently obtained peatland drainage statistics for Quebec Province and that other methods are being developed to track areas of drained peatland forests (Thompson et al., 2016). The Party also indicated that a peatland forest module for the CBM-CFS-3 model is being developed to facilitate the reporting of emissions from drainage of organic soils. The ERT recommends that Canada estimate the CO_2 emissions from drained organic forest soils by developing the peatland module for the CBM-CFS-3 model or any other country-specific methods. Pending the development of such methods, the ERT recommends that Canada estimate and report the CO_2 emissions using the tier 1 methodology and the default EFs in the 2006 IPCC Guidelines together with AD derived from the new statistics.	Yes. Completeness

ID[a]	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue[b]? If yes, classify by type
		The ERT also encourages Canada to explore the possibility of using the Wetlands Supplement for estimating CO_2, CH_4 and N_2O emissions from drained peatland forest land.	
L.17	4.A.2.1 Cropland converted to forest land – CO_2	The ERT noted that Canada did not include the loss of the biomass in cropland in the CSC in living biomass due to conversion of cropland to forest land. During the review, Canada explained that this was based on the assumption that there is no living biomass present when cropland is converted to forest land because afforestation will normally occur on abandoned cropland. In response to the preliminary main findings of the ERT shared with the Party, Canada further clarified that it does not have AD to determine how much of the cropland converted to forest land is abandoned cropland, for which Canada has never reported carbon stock gains or losses in the past. Canada also stated that the 2006 IPCC Guidelines (volume 4, chapter 2, p.2.19) allow the assumption of no change in initial biomass carbon stocks due to conversion, if data on previous land-use categories are not available. The ERT, however, notes that since Canada has used a tier 3 methodology for reporting biomass stock changes, it should follow the relevant guidance provided in the 2006 IPCC Guidelines (volume 4, chapter 2, p.2.20) and not that for the tier 1 methodology. It should, therefore, either include the carbon losses due to conversion from the previous land use to forest land or report those as "NE" in the CRF tables. The ERT recommends that Canada include the loss of the biomass in cropland in the CSC in living biomass due to conversion of cropland to forest land for all types of cropland, including abandoned cropland. If these biomass losses are already accounted for under cropland in the Century model, then the Party should transparently document how these are already accounted for in the NIR.	Yes. Completeness
L.18	4.D.2.2 Land converted to flooded land – CO_2	Canada estimates CO_2 emissions from land converted to flooded land (national reservoirs) using the level 3 approach as outlined in appendix 2 to the 2006 IPCC Guidelines. As illustrated in the NIR (part 2, figure A3-26, p.180), Canada uses a country-specific decay curve that shows that emissions due to land-use change take approximately 20–40 years to reach the natural background levels. However, rather than 40 years, Canada has used the default steady state period of 10 years for levels 1 and 2 given in appendix 2 to the 2006 IPCC Guidelines as the period required for the diffusive CO_2 emissions to reach natural background levels and thus for transferring these lands to flooded land remaining flooded land (i.e. unmanaged land). The ERT notes that emissions due to flooding of land continue to occur after 10 years when these areas are transferred to unmanaged land. During the review, Canada explained that it is currently using a tier 2 (level 2) approach based on guidance from appendix 2 to the 2006 IPCC Guidelines on flooded land, which recommends using a 10-year period to estimate CO_2 emissions due to flooding, which is also supported by country-specific research. The ERT, however, notes that the use of country-specific decay curves by the Party implies that it is using a level 3 (country-specific) approach as provided in appendix 2 to the 2006 IPCC Guidelines. The ERT recommends that Canada estimate the emissions from land converted to flooded land using either the level 2 approach (country-specific EFs) or the level 3 (country-specific methodology) approach given in appendix 2 to the 2006 IPCC Guidelines applying a set of assumptions (e.g. regarding the steady state transition period) that	Yes. Accuracy

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue? If yes, classify by type
		are appropriate to the approach selected. The ERT also recommends that the Party classify flooded land as land converted to flooded land or flooded land remaining flooded land using a transition period consistent with the assumptions regarding the steady state transition period used in the methodological approach selected.	
L.19	4.G Harvested wood products – CO_2	The previous ERT had made a recommendation requesting Canada to modify the reporting of the HWP pool, so that the HWP estimates can be compared with those of other Parties (see ID# L.14 in table 3). During the review, Canada provided information on data (disaggregated by product category) and calculations for the HWP pool together with information on carbon inputs, carbon losses and CO_2 emissions for CRF table 4.G.s1, which allowed the ERT to verify that the HWP model used by the Party is comparable to those used by other Parties. Canada also noted that figure 6-5 of the NIR already provides the net balance in the HWP pool (Mt CO_2 eq) including both carbon inputs and carbon losses and thus provides the information demonstrating that the approach used by Canada is comparable to that used by other Parties. The ERT, however, noted that the inclusion of additional information on calculations for the HWP pool together with the information on carbon inputs and carbon losses (disaggregated by product category) provided during the review would further enhance the transparency of the submission by enabling the ERT to assess the comparability of Canada's reporting on the HWP pool with that of other Parties. The ERT recommends that Canada provide in the NIR the information provided during the review on the data (disaggregated by product category) and calculations for the HWP pool together with the information on carbon inputs, carbon losses and CO_2 emissions for CRF table 4.G.s1 so as to enable the ERT to assess the comparability of Canada's reporting on the HWP pool with that of other Parties.	Yes. Transparency
Waste			
W.9	5. General (waste)	The ERT noted that Canada has not provided information on a detailed waste balance in the NIR, including the amounts of: waste generated, landfilled (managed and unmanaged), exported, composted, anaerobically digested at biogas facilities and incinerated (MSW); sewage sludge; and clinical and hazardous waste. The ERT notes that such information would enhance the transparency of the submission and allow the ERT to cross-check the information reported in the CRF tables. The ERT encourages Canada to include in the NIR a detailed waste balance, including the total amount of waste produced and its distribution between the different treatments.	Not an issue
W.10	5.A.1 Managed waste disposal sites – CH_4	Canada has used a DOC_f value of 0.6 to estimate CH_4 emissions from solid waste disposal in managed sites, which is different from the default value (0.5) provided in the 2006 IPCC Guidelines. During the review, Canada justified the use of this value for DOC_f, with the explanation that it considered that it best reflected the lower concentration of lignin in the MSW waste in Canada, since the majority of wood wastes from pulp and paper industries and saw mills in Canada are disposed of in dedicated wood waste landfills. Canada also informed the ERT that it has initiated a study to examine the applicability of the DOC_f factor used (0.6) across the various regions of Canada, including the Northern Territories, as well as throughout the time series.	Yes. Accuracy

ID[a]	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue[a]? If yes, classify by type
		The ERT recommends that Canada include in the NIR transparent information to substantiate the use of 0.6 as the value for DOC_f, including its applicability to MSW in various regions in Canada based on the new study cited examining the applicability of this value. The ERT further recommends that if the aforementioned study cannot provide evidence to substantiate the use of 0.6 as the country-specific value for DOC_f, and until such time as the Party can develop a robust country-specific DOC_f value, Canada use the default DOC_f value of 0.5 provided in the 2006 IPCC Guidelines. The ERT also encourages the Party to continue to work towards further refining the country-specific value for DOC_f.	
W.11	5.A.2 Unmanaged waste disposal sites – CH_4	The ERT noted that the annual amount of waste reported in CRF table 5.A under category 5.A.2 (unmanaged waste disposal sites) is not consistent with the wood waste amount reported in the NIR (part 2, table A3-63). During the review, the Party clarified that the differences are owing to the use of dry tonnes and hydrated mass in the NIR and the CRF tables, respectively. The ERT encourages the Party to report the same information on the annual amount of waste in category 5.A.2 in both the NIR and the CRF tables, using the same units, or provide an explanation for any difference in the NIR.	Not an issue
W.12	5.A.2 Unmanaged waste disposal sites – CH_4	The ERT noted that the DOC_f value (0.43) reported by Canada for category 5.A.2 (unmanaged waste disposal sites) in the CRF tables (table 5.A) is different from the value (0.5) reported in the NIR (part 2, annex 3, p.196) for the same category. During the review, Canada provided the explanation that although the value entered into the CRF Reporter was incorrect, the emissions were estimated using the correct value (0.5). The Party also informed the ERT that it would report the correct value (0.5) in CRF table 5.A in the next submission. The ERT recommends that the Party report the correct value for DOC_f in CRF table 5.A and implement QC measures so as to avoid such errors in future inventory submissions.	Yes. Transparency
W.13	5.C.2 Open burning of waste – CO_2, CH_4 and N_2O	Canada has not estimated emissions from open burning of MSW, reporting these emissions using the notation key "NE" for both biogenic and non-biogenic waste. Canada has, however, noted in CRF table 5.C (cells B21 and C24) that while open burning at landfills is banned by regulation in provinces and territories, there is anecdotal evidence that open burning does occur in mostly rural areas of the country. Canada has further explained that although it has not estimated these emissions owing to a lack of an "up-to-date" methodology, it does not expect it to be a large source of emissions relative to other activities. The ERT notes that there is no information in the NIR to demonstrate that these emissions are below the threshold defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. During the review, Canada explained that the likely level of emissions from open burning of MSW in Canada (as estimated for 2010) was nearly 100 kt CO_2 eq (or 0.015 per cent of total national GHG emissions), which is less than 0.05 per cent of the national GHG emissions and 500 kt CO_2 eq as specified in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. The ERT, however, noted that Canada has not included this justification in the NIR. The ERT recommends that Canada include in its NIR documentation to justify that the emissions from open	Yes. Transparency

ID[a]	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue[b]? If yes, classify by type*
		burning of MSW are below the thresholds defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	
W.14	5.D.1 Domestic wastewater – CH_4	Canada has estimated the CH_4 emissions from wastewater treatment using a methane correction factor value of 0.27. Canada has estimated this methane correction factor value by taking the arithmetic mean of the methane correction factor values for populations with the three different anaerobic treatments (facultative lagoons, septic systems and collected-untreated). During the review, Canada explained that since the populations served by each type of anaerobic system is not known, the methane correction factor of the anaerobic fraction was taken as the arithmetic mean of the methane correction factor values for the three types of systems (facultative (0.2), septic (0.5) and untreated (0.1)), which is then applied to the entire population served by anaerobic treatment systems. Canada also informed the ERT that it is working to determine the populations served by each treatment system type for the entire time series as an improvement planned for the inventory submission in 2019. The ERT notes that the value of the methane correction factor based on an arithmetic mean may result in an underestimation or an overestimation of the CH_4 emissions, depending on the population served by each type of treatment. The ERT recommends that Canada implement the planned improvement aimed at collecting data on the populations served by each type of anaerobic treatment (facultative lagoons, septic systems and collected-untreated) and recalculate the CH_4 emissions from domestic wastewater treatment for the entire time series based on application of the population-specific methane correction factor values.	Yes. Accuracy
W.15	5.D.1 Domestic wastewater – CH_4	The Party has reported the percentages of wastewater treated anaerobically by province in the NIR (part 2, table A3-70). The ERT noted that this parameter is nearly constant for the entire time series (1990–2015) for most provinces, with just a few variations in the values for Quebec Province from 1996 to 2001. During the review, Canada stated that, as mentioned in the NIR (part 2, table A3-70), the data from 1996 to 2006 were obtained from a study (AECOM, 2011) in which only the percentages of wastewater treated anaerobically in Quebec Province had fluctuations while those for the other provinces were constant. Canada also stated that owing to a lack of information, the values for the rest of the time series (before 1996 and after 2006) were assumed to remain constant. The Party also mentioned that it is working to determine the population served by various types of treatment for the entire time series as a planned improvement for the 2019 submission. The ERT recommends that Canada implement the planned improvement aimed at revising the percentages of the population served by different treatment types and use this information to recalculate CH_4 emissions from domestic wastewater for the entire time series.	Yes. Accuracy
W.16	5.D.1 Domestic wastewater – N_2O	Canada has used the methodology and default EFs in the Revised 1996 IPCC Guidelines to estimate N_2O emissions from wastewater treatment. Canada also did not estimate the values of $F_{NON-CON}$ and $F_{IND-CON}$ in CRF table 5.D, noting that the present country-specific methodology based on the methodology provided in the Revised 1996 IPCC Guidelines accounts for all nitrogen converted to N_2O and thus does not use these factors. Canada provided information justifying the use of a country-specific methodology based on the Revised 1996 IPCC Guidelines in the NIR (part 2, section A3.6.3). Canada cited a study (AECOM, 2012) that concluded that the use of	Not an issue

ID	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue[a] If yes, classify by type
		annual per capita protein available for consumption data could result in an overestimate of wastewater N_2O emissions and recommended the implementation of a consumption-based approach. During the review, Canada, however, informed the ERT that it is currently reviewing the methods for estimating N_2O emissions from wastewater treatment with regard to the appropriateness of default values for $F_{SON\text{-}CON}$ and $F_{IND\text{-}CON}$ for Canada. The Party also informed the ERT that Canada may use the methodology provided in the 2006 IPCC Guidelines or an updated country-specific method in future submissions as a planned improvement. The ERT encourages Canada to continue its efforts to develop country-specific values for the parameters $F_{SON\text{-}CON}$ and $F_{IND\text{-}CON}$.	
W.17	5.D.2 Industrial wastewater – CH_4	The ERT noted that there are significant fluctuations in the trend of CH_4 emissions from industrial wastewater treatment through the time series. Notably, emissions in 2001 increased by 705.4 per cent from the 2000 values and between 2007 and 2008 emissions decreased by 65.3 per cent, which could not be explained based on the amounts of CH_4 flared and captured for energy recovery. During the review, Canada explained that these fluctuations were owing to a computational error stemming from the omission of the methane recovery in one large facility between 2001 and 2007. The Party also indicated that this error would be corrected in the next submission. The ERT recommends that Canada recalculate CH_4 emissions from industrial wastewater, including the methane recovery reported by all facilities, for the entire time series.	Yes. Accuracy

[a] Recommendations made by the ERT during the review are related to issues as defined in paragraph 81 of the UNFCCC review guidelines. Encouragements are made to the Party to address all findings not related to such issues.

Annex I

Overview of greenhouse gas emissions and removals for Canada for submission year 2017 as submitted by Canada

Table 6 shows total GHG emissions, including and excluding LULUCF and, for Parties that have decided to report indirect CO_2 emissions, with and without indirect CO_2. Tables 7 and 8 show GHG emissions reported under the Convention by Canada by gas and by sector, respectively.

Table 6
Total greenhouse gas emissions for Canada, 1990–2015
($kt\ CO_2\ eq$)

	Total GHG emissions excluding indirect CO_2 emissions		*Total GHG emissions including indirect CO_2 emissions*[a]	
	Total including LULUCF	*Total excluding LULUCF*	*Total including LULUCF*	*Total excluding LULUCF*[b]
1990	511 725.90	611 000.78	512 435.17	611 000.78
1995	585 137.87	661 279.65	585 870.97	661 279.65
2000	675 773.39	738 185.65	676 405.20	738 185.65
2010	672 652.41	700 838.00	673 115.52	700 838.00
2011	681 394.88	707 445.93	681 852.58	707 445.93
2012	686 765.66	716 284.61	687 267.83	716 284.61
2013	699 809.14	729 206.93	700 298.08	729 206.93
2014	694 232.20	727 158.16	694 662.09	727 158.16
2015	688 257.93	721 801.45	688 698.16	721 801.45

Note: Emissions/removals reported in the sector other (sector 6) are not included in total GHG emissions.

[a] Canada has reported indirect CO_2 emissions in CRF table 6.

[b] The value for total GHG emissions including indirect CO_2 emissions and excluding LULUCF differs from the corresponding entry in CRF table summary 2 for Canada, as the value reported in CRF table summary 2 also includes indirect CO_2 emissions from the LULUCF sector.

Table 7
Greenhouse gas emissions by gas for Canada, excluding land use, land-use change and forestry, 1990–2015
(kt CO_2 eq)

	CO_2[a]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3
1990	463 496.84	93 532.06	42 217.19	970.54	7 557.90	NA	3 225.93	0.32
1995	495 510.75	110 981.65	45 702.09	460.51	6 349.22	NA	2 275.16	0.28
2000	569 999.95	117 997.57	39 544.51	2 754.84	4 985.57	NA	2 902.96	0.24
2010	553 720.59	99 750.04	37 293.12	7 774.50	1 859.18	NA	440.42	0.15
2011	560 003.14	99 991.57	36 769.56	8 598.95	1 687.38	NA	395.18	0.15
2012	565 458.15	101 742.16	37 768.86	9 077.01	1 798.64	NA	439.63	0.15
2013	574 471.57	103 697.45	39 552.50	9 430.17	1 617.10	NA	437.98	0.15
2014	572 728.38	104 775.08	38 137.93	10 065.96	1 088.04	NA	362.63	0.15
2015	568 094.19	102 399.97	38 901.21	11 014.12	967.92	NA	423.90	0.15
Per cent change 1990–2015	**22.6**	**9.5**	**–7.9**	**1 034.8**	**–87.2**	**NA**	**–86.9**	**–53.4**

Note: Emissions/removals reported in the sector other (sector 6) are not included in total GHG emissions.
[a] Canada did not report indirect CO_2 emissions in CRF table 6, except for indirect CO_2 emissions from the LULUCF sector.

Table 8
Greenhouse gas emissions by sector for Canada, 1990–2015
(kt CO_2 eq)

	Energy	IPPU	Agriculture	LULUCF	Waste	Other
1990	482 707.71	55 875.41	48 517.02	–98 565.61	23 900.64	NA
1995	524 400.58	56 945.84	55 192.41	–75 408.69	24 740.82	NA
2000	602 186.00	52 260.83	57 955.55	–61 780.45	25 783.28	NA
2010	571 375.17	48 474.66	56 193.26	–27 722.48	24 794.90	NA
2011	575 279.17	52 115.84	55 298.37	–25 593.35	24 752.55	NA
2012	578 318.42	56 488.04	57 190.58	–29 016.78	24 287.57	NA
2013	591 702.00	53 501.88	59 605.90	–28 908.85	24 397.15	NA
2014	593 505.15	50 902.59	58 192.68	–32 496.08	24 557.74	NA
2015	587 071.54	51 069.74	58 961.64	–33 103.30	24 698.54	NA
Per cent change 1990–2015	**21.6**	**–8.6**	**21.5**	**–66.4**	**3.3**	**NA**

Notes: (1) Emissions/removals reported in the sector other (sector 6) are not included in total GHG emissions. (2) Totals include indirect CO_2 emissions reported in CRF table 6.

Annex II

Additional information to support findings in table 2

Missing categories that may affect completeness

The categories for which methods are included in the 2006 IPCC Guidelines that were reported as "NE" or for which the ERT otherwise determined that there may be an issue with the completeness of reporting in the Party's inventory are the following:

(a) 1.A.3.c Railways – CO_2, CH_4 and N_2O emissions from steam trains (see ID# E.14 in table 3);

(b) 2.A.4 Other process uses of carbonates – CO_2 emissions from ceramics production (see ID# I.2 in table 3);

(c) 2.B.6 Titanium dioxide production – CO_2 emissions (see ID# I.4 in table 3);

(d) 2.B.8 Petrochemical and carbon black production – CO_2 and CH_4 emissions from ethylene oxide production (see ID# I.5 in table 3);

(e) 3.B Manure management – CH_4 and N_2O emissions from anaerobic lagoon and daily spread (see ID# A.3 in table 3);

(f) 3.D Direct and indirect N_2O emissions from agricultural soils – N_2O and related indirect N_2O emissions (3.D.b) from sewage sludge and other organic fertilizer applied to managed soils (see ID#s A.6 and A.7 in table 3);

(g) 4.B.2 Wetlands and settlements converted to cropland – all carbon pools (see ID# L.1 in table 3);

(h) 4.C Grassland remaining grassland – CO_2 emissions from organic and mineral soils (see ID# L.1 in table 3);

(i) 4.E.2 Cropland and wetlands converted to settlements (see ID# L.1 in table 3);

(j) 4(II) Emissions and removals from drainage and rewetting and other management of organic/mineral soils – CH_4 and N_2O from drainage of organic soils on forest land (see ID# L.16 in table 5);

(k) 4(III) Direct N_2O emissions from N mineralization/immobilization – N_2O emissions from forest land, grassland remaining grassland and settlements and related indirect N_2O emissions from managed soils (category 4(IV)) (see ID# L.10 in table 3);

(l) 4.A CO_2 emissions from biomass stock changes due to conversion of cropland to forest land (see ID# L.17 in table 5);

(m) 5.B.2 Anaerobic digestion at biogas facilities – CH_4 emissions from anaerobic digestion at biogas facilities (see ID# W.4 in table 3).

Annex III

Documents and information used during the review

A. Reference documents

Reports of the Intergovernmental Panel on Climate Change

IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. S Eggleston, L Buendia, K Miwa, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl.

IPCC. 2014. *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol*. T Hiraishi, T Krug, K Tanabe, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at http://www.ipcc-nggip.iges.or.jp/public/kpsg.

Intergovernmental Panel on Climate Change. 2014. *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*. T Hiraishi, T Krug, K Tanabe, et al. (eds.). Available at http://www.ipcc-nggip.iges.or.jp/public/wetlands/.

Annual review reports

Reports on the individual review of the 2011, 2012, 2013, 2014, 2015 and 2016 inventory submissions of Canada, respectively, contained in documents FCCC/ARR/2011/CAN, FCCC/ARR/2012/CAN, FCCC/ARR/2013/CAN, FCCC/ARR/2014/CAN, FCCC/ARR/2015/CAN and FCCC/ARR/2016/CAN.

Other

AECOM Canada. 2011. *Improved Methodology for the Estimation of Greenhouse Gases from Canadian Municipal Wastewater Treatment Facilities*.

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Aggregate information on greenhouse gas emissions by sources and removals by sinks for Parties included in Annex I to the Convention. Note by the secretariat. Available at http://unfccc.int/resource/webdocs/agi/2017.pdf.

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Marinier M, Clark K and Wagner-Riddle C. 2004. *Improving Estimates of Methane Emissions Associated with Animal Waste Management Systems in Canada by Adopting an IPCC Tier 2 Methodology*. Final report submitted to the Greenhouse Gas Division, Environment Canada, by the Department of Land Resource Science. Guelph (ON): University of Guelph.

Statistics Canada. 2008. *Alternative Livestock on Canadian Farms: Census Years 1981, 1986, 1991, 1996, 2001 and 2006* (Catalogue # 23-502-X). Available at http://www.statcan.gc.ca/pub/23-502-x/23-502-x2007001-eng.pdf.

Thompson DK, Simpson BN and Beaudoin A. 2016. Using forest structure to predict the distribution of treed boreal peatlands in Canada. *Forest Ecology and Management*. 372(2016): pp.19–27.

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Lindsay Pratt, (Environment and Climate Change Canada), including additional material on the methodology and assumptions used. The following document [1] was also provided by Canada:

Metsaranta, J.M., Shaw, C.H., Kurz, . W.A. Boisvenue, C. and Morken S. 2017. *Uncertainty of inventory-based estimates of the carbon dynamics of Canada's managed forest* (1990–2014) Can. J. For. Res. 47: 1082–1094 (2017) dx.doi.org/10.1139/cjfr-2017-0088.

[1] Reproduced as received from the Party.